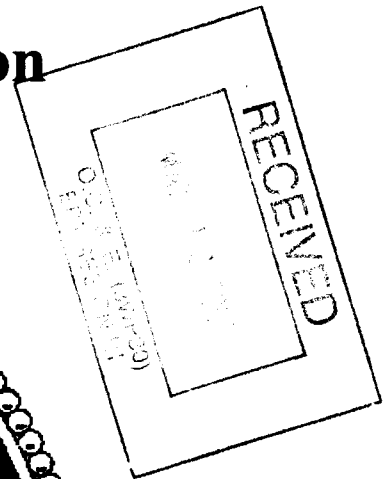
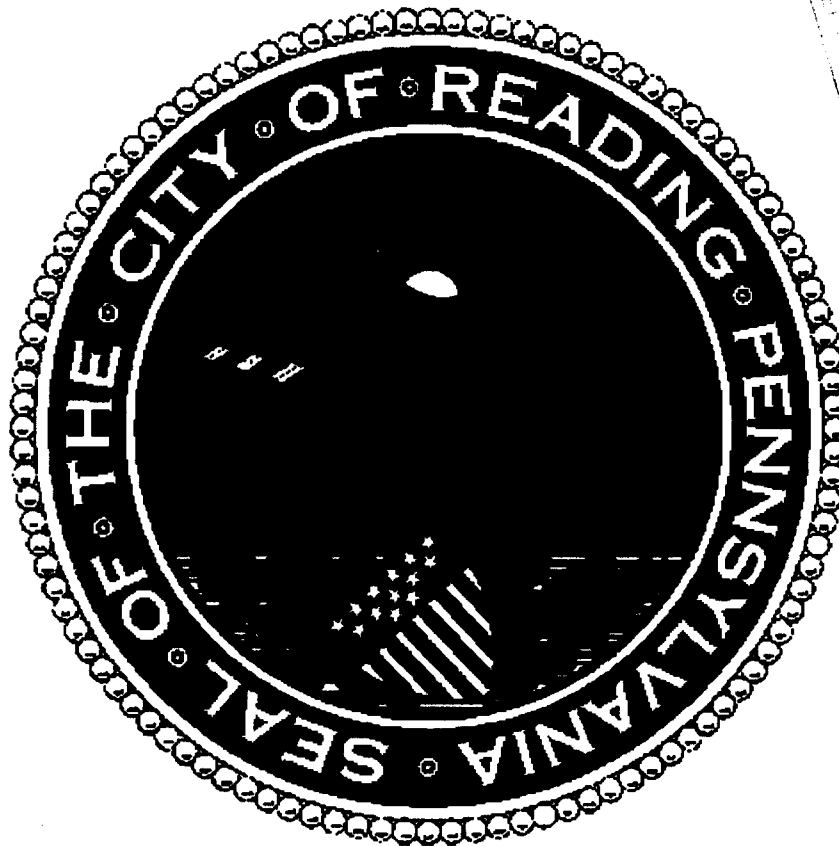


CITY OF READING
Consent Decree Submission



Paragraph 29
WET WEATHER
OPERATION PLAN

May, 2007

CONSENT DECREE REQUIREMENT:

29. Wet Weather Operation Plan. By no later than eighteen (18) months from the Entry Date, the Defendant shall develop and submit a "Wet Weather Operation Plan" (WWOP) and a schedule for implementation to EPA and PADEP for review and approval in accordance with Paragraph 43 of this Decree. The WWOP shall set forth how to operate the treatment plant and the collection system during wet weather events to maximize treatment and prevent sanitary sewer overflows (SSOs) or bypasses. This Plan shall build on and update the development of the Interim Wet Weather Operational Strategy described above at Paragraph 17 of this Decree. The WWOP shall adequately address any comments from EPA and PADEP on that wet weather operational strategy. The WWOP shall also provide for and include a log of any SSO events which identify the nature of the storm events, the locations of the SSO discharges, and the duration and estimated volume of the SSO discharges. Upon approval from EPA & PADEP, the Defendant shall implement the WWOP.

CITY RESPONSE

By no later than eighteen (18) months from the Entry Date, the Defendant shall develop and submit a "Wet Weather Operation Plan" (WWOP) and a schedule for implementation to EPA and PADEP for review and approval in accordance with Paragraph 43 of this Decree.

WWOP Schedule for Implementation

KEY: SP = standard practice SOP = standard operating Procedure PS = pump station MH = Manhole

Location/Description	Target Start Date	Target Completion Date
Collection System - Operations		
System flow monitoring baseline	n/a	Complete
Cleaning and televisual inspection of sanitary sewers based on consumer complaint data	Ongoing	n/a
Establish storm sewer flood zones for inspection and cleaning twice monthly	Ongoing	n/a
Establish sanitary critical areas for inspection twice monthly and cleaning as needed	Ongoing	n/a
Prioritized subarea testing and evaluation	Ongoing	n/a
Geospatial computerized maintenance management software implementation	In progress	November 2007
GPS field location of system	In progress	November 2007

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WWOP Schedule for Implementation

KEY: SP = standard practice SOP = standard operating Procedure PS = pump station MH = Manhole

Location/Description	Target Start Date	Target Completion Date
Sanitary sewer GIS layers	In progress	November 2007
Baseline infiltration and inflow (I&I) report	In progress	June 2007
Sanitary sewer system evaluation survey	In progress	January 2008
Sixth & Canal Pump Station (6&CPS)		
Bar screen #2 - rebuild & return to service	n/a	Complete
Bar screen #1 - rehabilitate	n/a	Complete
Prepare and implement SP	n/a	Complete
Resolve SCADA communication problems	n/a	Complete
Prepare and implement SOP	July 2007	December 2007
SCADA control updates	July 2007	December 2007
Install waterproof bar screens motors	2008	2008
Pre-pipe for portable bypass pumping	2008	2008
Modifications to minimize sandbag needs	2009	2009
Remote control of influent and bypass gates	2009	2009
19th Ward Pump Station (19th Ward PS)		
Evaluate and document overflow level	n/a	Complete
Create elevation document for sewers	n/a	Complete
Evaluate pumping system curve	n/a	Complete
Prepare and implement SP	n/a	Complete
Track and record wet-well level	n/a	Complete
Study overflow monitoring options	n/a	Complete
Baseline wastewater sampling and analysis	n/a	Complete
Convert SP to an SOP, including sampling	July 2007	December 2007
Evaluate upstream pump stations' max. flows	2008	2009
Evaluate options to the overflow monitoring	2008	2008
Install a pump station data logger	2008	2008
Evaluate SCADA access to the pump station	July 2007	December 2007
Implement improved overflow monitoring	2009	2009
18th Ward Pump Station (18th Ward PS)		
Install pump #4 temporary VFD	n/a	Complete
Resolve SCADA communication problems	n/a	Complete
Prepare and implement SOP	July 2007	December 2007
SCADA control updates	July 2007	December 2007
West Reading Pump Station (WRPS)		
Prepare and implement SP	n/a	Complete
Monitor for infiltration and inflow (I&I)	Ongoing	n/a
Prepare and implement SOP	July 2007	December 2007
Fritz Island Grit Chamber (FIGC)		
Prepare and test SP	Ongoing	n/a
Automate discharge gates – opening	n/a	Complete

WWOP Schedule for Implementation

KEY: SP = standard practice SOP = standard operating Procedure PS = pump station MH = Manhole

Location/Description	Target Start Date	Target Completion Date
Evaluate discharge pipes hydraulic capacities	April 30, 2007	October 31, 2007 or earlier
Prepare and implement SOP	July 2007	December 2007
Install SCADA monitoring and control	July 2007	December 2007
Wastewater Treatment Plant (WWTP)		
Interim Wet Weather Operational Strategy	n/a	Complete
Refine the Storm Flow SOP for the WWTP	n/a	Complete
Update evaluation of effluent pump(s)	n/a	Complete
6&CPS pump controls adjustment	Ongoing	n/a
Solids Washout Reassessment	Ongoing	n/a
Evaluate WWTP maximum hydraulic load	April 30, 2007	October 31, 2007 or earlier
Storm Flow SOP Contingency Plan	2009	2009
General WWOP Items		
Briefing and debriefing process	Ongoing	n/a
Annual WWOP Review	Prior to May 30, 2007	Prior to May 30, 2007
Flood Response/Remediation/Recovery SOP	During 2008	During 2008

The WWOP shall set forth how to operate the treatment plant and the collection system during wet weather events to maximize treatment and prevent sanitary sewer overflows (SSOs) or bypasses. This Plan shall build on and update the development of the Interim Wet Weather Operational Strategy described above at Paragraph 17 of this Decree.

The City of Reading's written Wet Weather Operation Plan (WWOP) covers the collection system, four wastewater pumping stations' systems, the Fritz Island grit chamber and the Fritz Island wastewater treatment plant (WWTP). The City's WWOP is designed to achieve and/or maintain compliance with NPDES Permit No. PA 0026549, along with all other applicable permits, laws and regulations. It also assures compliance with the Consent Decree's Remedial Measures, General Duties,

Paragraph 7 – Duty to Comply with Permit, and

Paragraph 8 – Operation and Maintenance of the Facilities.

Proper operation and maintenance of the collection system, pump stations, Fritz Island grit chamber and WWTP prior to and during wet weather events is important to accomplishing continuous and reliable performance. Having a strategy to assure the WWTP performance (maximizing the flow to the treatment plant and through the treatment plant while minimizing the washout of solids throughout the treatment process) during wet weather events is essential to regulatory compliance.

The preparation of the City's WWOP consisted of a:

- A historical review and/or status review for each site/location

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- a coordination with the City's *management*, operation and maintenance plan (City's MOM plan)
- cross references to the Consent Decree Submissions covering the Interim Trickling Filter Performance Measures and the Process Control Testing Plan
- hydraulics engineer and a wastewater microbiology expert evaluation reports
- experience gained from numerous wet weather events from October 2005 to date

This written description of the City's Wet Weather Operation Plan is separated into eight (8) sites/locations including one (1) General Practices section.

- I. Collection System
- II. Sixth and Canal Pump Station
- III. 19th Ward Pump Station
- IV. 18th Ward Pump Station
- V. West Reading Pump Station
- VI. Fritz Island Grit Chamber
- VII. Wastewater Treatment Plant (WWTP)
- VIII. General Practices

I. Collection System

The City's collection system consists of approximately 164 miles of gravity sewer lines up to 54" in diameter including some oblong and unusual pipe shapes. The City's system also includes four pumping stations and approximately 15,000 feet of force main up to 42" in diameter. The collection system serves approximately 81,000 City residents as well as industrial, commercial, and public users within approximately 10 square miles. Additionally, the City's service area includes thirteen (13) surrounding municipalities with which the City has intermunicipal agreements for sanitary sewer service. Based on self-reported information from these municipalities, there are an additional 250 miles of tributary sewer lines serving an estimated 49,000 residents and users. These tributary sewers, both gravity and pumped, are interconnected to each other's collection systems and the City's collection system and wastewater treatment plant with approximately forty (40) points of connection. Appendix A, City of Reading Sanitary Sewer Service Area, is a draft figure created by Black & Veatch (B&V) that maps the City's collection system and structures and the approximate areas of the portions of the tributary municipalities. Appendix B, Sanitary Sewer Collection System, Wastewater Treatment Plant Tributary Flow Schematic, shows the general flow connections of tributary municipalities to the key areas within the City's wastewater system.

Following are the presentation categories for the WWOP for the Collection System.

- A. History, Coordination, Cross References, Evaluations and/or Experiences
- B. Flow Maximizing Strategy Development
- C. Implementation, Training and Safety
- D. Process Monitoring and Data Compilation

A. History, Coordination, Cross References, Evaluations and Experiences

The development of the City of Reading's sewer infrastructure mirrors the growth and progress of the City. Since the City was a major transportation and manufacturing center in the late 1800's, a wastewater infrastructure was developed to accommodate the City's residents and industries. In the mid-1890's, the City began to design and construct a separate sanitary sewer system. As such, many of the City's gravity sewers were built at the turn of the last century and are today 100 years or older. Another burst of development led to additional sewer infrastructure in the 1930's. The majority of the collection system that serves the City today has been in operation since the 1930's with the design and layout of the sewer system by house districts for the areas. Additional growth in the 1950's and 1960's in the City and the surrounding suburbs provided the impetus for some of the last major additions to the City limits proper and the City's internal sewer service area.

The City's sewer system has experienced problems that are not unique to a system of this age. When designed and installed, water conservation methods were not employed as they are today which reduces both industrial and residential discharge volumes and increases the need for line cleaning. The pipe materials used for construction allow excess flow to infiltrate into the sanitary sewer system. The pipe sections are shorter than current materials requiring more joints which can be another place for a failure allowing excess flows to enter the system. Improvements in machinery, equipment, and construction methods in general have occurred since the installation of the City's collection system. In the City, most other utilities are underground with the sanitary sewer being the deepest. This can be adversely impacted by construction preformed by others above the sewer lines. Each of these factors contributes to the challenges of maintaining an aging collection system and managing the wet weather flows received and transported.

During the industrial growth of the City and the design and construction of the sanitary sewer system, the City employed a large number of surveyors on staff to maintain accurate, up-to-date maps for the collection system. However, over the past decades, this focus has decreased with the status of current mapping a major problem for maintenance personnel in the collection system. Additionally, the City began to use engineering consultants without requiring as-built documentation as a standard for the projects upon completion. The estimated pipe lengths above are based upon electronic measure of a digitized electronic map created from a paper map. In order to obtain accurate mapping and inventory of the collection system, the City has contracted for the field inventory and electronic map development for both the sanitary and storm sewer systems to be accessible through a geographic information system (GIS). As the field inventory and electronic mapping is developed, the City's collection system inventory will reflect the current data and reduce the reliance on institutional knowledge.

B. Flow Maximizing Strategy Development

As noted by Black & Veatch (B&V) when they began their evaluation of the City's system, the actual layout and design of the gravity collection system is done in an attempt to

maximize flows and provide for some storage during high flow events. The City's sewer system has a unique grid design allowing most manholes to have flow leaving via multiple pipes dependent upon the flow level in the manhole. This allows flow to surcharge in an upstream location and travel a different 'relief' route to reach a common downstream destination. Also, some key areas of the interceptors have a separate 'relief' interceptor that appears to have been added at a later date to allow for both storage and an alternate flow route.

The City is required by the Consent Decree to conduct an Infiltration/Inflow Analysis by Subsystem (I&I). For this task which includes rainfall and flow monitoring, the City has contracted with B&V to take the lead role. This study and the requisite Sanitary Sewer System Evaluation Study also being conducted in conjunction with B&V will serve as the starting place for the City's strategy for reducing extraneous groundwater and rainfall-induced flows and maximizing flow in general through the collection system to the WWTP. The City will employ a variety of proven techniques including televisual inspection, air testing, and smoke testing to evaluate the condition of the lines in identified subsystems. For the initial flow maximizing, the larger sources of extraneous flows will be targeted.

C. Implementation, Training and Safety

Upon completion of the I&I report by B&V and the City's review, the City will evaluate the recommendations to begin implementation. Additional study in some subsystems is required to pinpoint the specific problem areas and to effectively address the removal of extraneous baseline flows and the minimization of inflow during rain events. B&V is developing standards and specifications to be used for additional study as well as the resultant remediation techniques. The City will work closely with the consultants in order to have ownership in the beginning phase of the ongoing program and to use this as a training opportunity for employee development.

The City determined the best way to monitor requests for service and track maintenance activities in the collection system is to employ a geospatial database for a work order and maintenance management system. The City selected software vendor and implementation contractor will build upon the developing GIS database. With the anticipated ability to view problem areas as determined by service call volume, City personnel will be able to direct their time to investigating and correcting problems prior to their adversely impacting wet weather operations. Additional use of technology and the ongoing training of personnel in the use of technology for system inspection, testing, and maintenance is a critical component of the City's ongoing wet weather operations strategy to prioritize limited financial and human resources.

D. Process Monitoring and Data Compilation

To minimize SSO events during wet weather conditions, the City of Reading has established a standard program to manage both the sanitary and storm sewer collection systems. The preventive maintenance program established has evaluated areas that have been problematic

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in the past and have been identified as a source of a possible SSO condition if a wet weather event is experienced. The storm sewer preventive inspection is discussed here since any SSO event that may occur would likely enter the storm sewer system via a catch basin or manhole. The same crew performs the work on both sewer collection systems.

The sanitary sewer system has been evaluated to record the areas that require more maintenance based on normal operating parameters. To prevent SSO conditions a checklist of the zones that need more maintenance has been established. The work order will be generated twice every month and the areas will be inspected for the flow present with cleaning following based on the standards established in the Sanitary Sewer Collections System Inspection SOP. Overall condition of the City of Reading's sanitary sewer system will also be evaluated as the work request is performed.

The storm sewer system has the same work order program established as the sanitary sewer system. The storm sewer system preventive maintenance program has identified the areas that are prone to flooding conditions. The work order is generated twice every month and the areas are inspected for the flow present. Cleaning will follow based on the standards established in the storm sewer system SOP. Flood zones, catch basins and the bridges through out the City of Reading are included on this work order location list. Overall changes in condition of the storm sewer system are evaluated as the work order is performed.

The current sewer systems' work order system is a workflow program that is built to change based on information collected from current conditions and future conditions of both the sanitary and storm sewer systems. Information obtained from the I&I report by B&V and the developing GIS database will ensure that the City of Reading will have the most current information to allow the workflow program to grow and evolve as conditions dictate.

If an SSO or other emergency overflow is noted during wet weather, then the SOP will be placed into action and samples will be collected and analyzed for key conventional permit parameters.

II. Sixth and Canal Pump Station

The Sixth and Canal Pump Station serves the vast majority of the City proper and also receives the 19th Ward Pump Station flows including portions of Bern and Spring Townships. Also, portions of Alsace Township, Laureldale Borough, Lower Alsace Township, Mount Penn Borough and Muhlenberg Township discharge into the City's Sixth and Canal Pump Station service area. The City has a separate storm sewer system.

The pump station consists of a main sluice gate prior to two automatic mechanical bar screens with a manually cleaned bar screen in a bypass channel, a bypass sluice gate and channel with manually cleaned bar screen, a grit removal system with bypass channel and two parallel wet-wells. This pump station functions as one of the two headworks facilities for the WWTP by providing preliminary treatment. There are six 250 hp, 6000 gpm vertical dry pit pumps and the control system includes dual programmable logic controllers (PLCs). The second PLC functions

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as a backup unit. The control system can be monitored and controlled remotely through the City's SCADA system, and it is backed up by an automatic alarm dialer system. There is a flow meter with recorder, two automatic emergency generators and a gated bypass to the Schuylkill River.

Following are the presentation categories for the WWOP for the Sixth and Canal Pump Station.

- A. History, coordination, cross references, evaluations and experiences
- B. Flow Maximizing Strategy Development
- C. Implementation, Training and Safety
- D. Process Monitoring and Data Compilation

A. History, Coordination, Cross References, Evaluations and Experiences

The Sixth and Canal Pump Station was part of the City's original wastewater system constructed in the mid-1890's to transport sanitary flows across the Schuylkill River to the rural outskirts of the City near the confluence of the Angelica Creek. The original pump station was powered by steam and located near the canal used to access the river. The pump station was upgraded several times in the next century culminating in 1988 with the configuration that exists today. The pump station at that time had six 150 hp pumps and was unable to meet the 43.2 MGD peak design flow. This resulted in the station's gated bypass being used during high flows in order to protect station proper from water damage to the electric systems and to protect the nearby area from backups and sanitary sewer overflows into the streets. As a result, this station was upgraded in 2002 as described above to be able to convey the designed flows. Since the pump station upgrade, the gated bypass has only been used two times – 2003 and 2005.

The first recent bypass occurred in July 2003 when wet weather flows coincided with a single phase of power loss. When automatically switching the station to generator power, a control board failed on one of the two generators. The gated bypass was used for three minutes while the pump controls for half the station were manually adjusted to allow the pumps to pump beyond the programmed speed to compensate for the lack of the other half of the pumps. The recurrence of this combination of simultaneous failures is highly improbable.

During the four high flow events in the past year, we learned how to refine the pump station's operation to maximize throughput and minimize the use of the gated bypass to the Schuylkill River. There was only one partial bypass conducted for a limited time in October 2005, and that was previously reported as required. At that time, the pump station's effluent flow meter and the WWTP's influent flow meter on that line measured in excess of 50 MGD which exceeds the peak design flow showing that the station performed beyond design.

B. Flow Maximizing Strategy Development

The 2002 upgrade of the six pumps and their control system was the major factor for maximizing the flow through the Sixth and Canal Pump Station during high flow events.

To prevent any premature use of the gated bypass, we made a minor modification to the pump station and use sandbags to allow for additional internal "flooding" during high flows and still protect the critical pumping components from being compromised. Additional improvements that are scheduled are listed in the WWOP Schedule for Implementation above.

C. Implementation, Training and Safety

The standard practice is that the pump station will be operated at full capacity during a high flow event, and this is automatically controlled by the state of the art electronic control system. Preventive measures for allowing internal "flooding" are instituted when severe high flow events are probable. Any use of the bypass gate must be authorized by an appropriately certified manager or a certified supervisor in the absence of a manager.

If the gated bypass is not useable due to a high river level, then portable bypass pumping will be implemented. Preventive measures of setting up the bypass pump(s) is standard practice when ever high flow and external flooding are a concern.

If the pump station is at risk of being lost due to external flooding during a high flow event then safety measures and protection of critical components are exercised. Motors for two of the pumps are hoisted to the highest possible level, all critical control components are removed, external and generator electric are disconnected/shut down and personnel are evacuated. The last step before evacuation is the closing of the main sluice gate and bypass sluice gate to prevent internal "flooding" of the pump station while it is abandoned. These safety measures assure danger for the personnel are minimized, damage to facilities is minimized and return to normal operation is expedited. This greatly reduces the overall duration of health risks and environmental impacts as compared to a total loss of the pump station operation.

Described below is the **WWOP Schedule for Implementation** for the Sixth and Canal Pump Station items that are ongoing and/or planned.

- Prepare and implement a standard operating procedure (SOP)

 - A High Flow SOP will be prepared. Presently there are various SOPs in place and High Flow standard practices (SPs) in use.

- SCADA control updates

 - The SCADA system's ability to control the Sixth and Canal PS from remote locations will be expanded.

- Install waterproof bar screens motors

 - Presently the bar screens motors submerge during High Flow events and we have to shut them off. We want to maintain bar screens operability during High Flows.

- Pre-pipe for portable bypass pumping

 - Having pre-installed piping will improve the WWOP by reducing the mobilization time and labor. It will also assure appropriate setup of intake and discharge piping.

Modifications to minimize sandbag needs

Making some vulnerable penetrations and openings watertight by replacing some fixtures and installing others will improve the WWOP by having the PS continuously protected. It will also reduce mobilization time and labor that sandbagging requires. Some sandbagging will still need to be performed.

Remote control of influent and bypass gates

Being able to control these gates from in the PS or from a remote site will improve our flexibility to maximize flows into and through the PS.

D. Process Monitoring and Data Compilation

Daily composite and grab samples are taken at 6th and Canal and analyzed for certain conventional permit parameters such as BOD₅, pH, Ammonia and TSS. When a bypass occurs, grab samples may be taken and analyzed for certain conventional permit parameters.

III. 19th Ward Pump Station

The 19th Ward Pump Station serves the City's 19th Ward and receives flow from portions of both Spring and Bern Townships. This pump station has a gravity overflow that discharges into the Tulpehocken Creek.

The pump station consists of two influent channels, with a comminutor in each, feeding into a wet-well. There are three 75 hp, 1530 gpm vertical dry pit pumps and a standard electrical control system with dual level sensors. There is a flow meter with recorder, wet-well level recorder, an automatic emergency generator and an automatic alarm dialer system to call the emergency phone numbers.

Following are the presentation categories for the WWOP for the 19th Ward Pump Station.

- A. History, Coordination, Cross References, Evaluations and Experiences
- B. Flow Maximizing Strategy Development
- C. Implementation, Training and Safety
- D. Process Monitoring and Data Compilation

A. History, Coordination, Cross References, Evaluations and Experiences

The 19th Ward pump station was originally constructed in the 1950's to expand the City's sanitary sewer service area as development sprawled from the urban center city. The pump station had some mechanical upgrades during 1995 as well as the addition of an emergency generator. As many power outages occur during wet weather, the addition of this generator eliminated many potential wet weather overflows.

This station contains an overflow to the Tulpehocken Creek which keeps the station from being damaged when excessive wet weather flows are received. In the past five years, this station had a confirmed overflow that occurred in 2003 due to a level alarm/control malfunction as well as the prior year's events discussed below.

We experienced two brief overflows during 2006 as a result of intense, heavy rain events. Both overflows occurred after a hydraulics engineer had been contracted. The timing of these two events has allowed us to analyze overflows in more detail and thus giving us a better understanding of the standard practices available for us to maximize pumped flow and minimize overflows. These two overflow events have been previously reported as required.

The hydraulics engineer was contracted to evaluate this pump station due to the existing overflow piping, need to maximize pumped flow, need to minimize overflows and proper monitoring and documentation of any overflow events. The engineer's three reports are included in Appendix C.

B. Flow Maximizing Strategy Development

The flow maximization strategy is to assure the pump station is properly operated and maintained on an ongoing basis and under normal conditions so it functions properly and maximizes flow during any high flow event. This includes increasing the frequency of operational and maintenance inspections, monitoring, and documentation to aid in assuring the readiness of the pump station to handle peak wet weather flows. We are evaluating the overflow monitoring and measuring options proposed to determine the best course of action. The recommended Infiltration & Inflow (I&I) programs will be considered by the City in the context of the I&I Analysis by Subsystem and Sanitary Sewer System Evaluation Study being performed by B&V. The information may be presented to the two contributing municipalities for their future implementation

Additional study of the tributary area may be required with a coordinated effort with the two contributing municipalities. The coordinated study would be to determine the current and projected future peak flows from each gravity and pumped source, and to compare the flow distribution from said peak capacities. Specifically the comparison of the peak capacity of the tributary pump stations and the 19th Ward Pump Station would be compared when reviewing the impact of wet weather flows and projecting overflow conditions.

C. Implementation, Training and Safety

There is a standard practice of routine operational inspections of the 19th Ward Pump Station by each of the three daily shifts. There are also separate weekly preventive maintenance inspection and testing of the pump station by both the mechanical and the electrical maintenance teams. The operational and maintenance inspections assure the pump station is functioning properly during normal conditions and that it is ready to maximize pumped flow during any high flow event. There is also a standard practice to inspect the pump station during any heavy rain event or alarm to assure all pumps are functioning properly and maximizing said pumped flow.

Described below is the **WWOP Schedule for Implementation** for the 19th Ward Pump Station items that are ongoing and/or planned.

Convert SPs to an SOP, including sampling

A comprehensive SOP will be created based on the present SPs, including sampling.

Evaluate upstream pump stations' maximum flows

An evaluation will be conducted to assess the maximum capacity of the 19th Ward PS to upstream PSs (and gravity flows) to assure there is not a pumping capacity issue.

Evaluate options to the overflow monitoring system

Presently a wet-well level recorder can estimate if an overflow occurred and for approximately how long. Optional monitoring and measuring system are being evaluated and considered.

Install a pump station data logger

This will be an interim step until a SCADA link can be made.

Evaluate SCADA access to the pump station

SCADA access to this remote and low elevation site is difficult and expensive. We are evaluating options to find a reliable and economic way to monitor and control this pump station through the SCADA system.

Implement improved overflow monitoring

Install an improved overflow monitoring and measuring system once a reliable and economical solution is chosen.

D. Process Monitoring and Data Compilation

We performed monitoring of the 19th Ward Pump Station to develop information for a baseline comparison. Analysis will include certain conventional permit parameters. This High Flow SOP will include instructions that when an emergency overflow is noted, then samples will be collected and analyzed for certain conventional permit parameters.

IV. 18th Ward Pump Station

The 18th Ward Pump Station serves a substantial portion of the City's 18th Ward and receives flow from the City's West Reading Pump Station. It also receives flow from portions of Cumru Township, Mohnton Borough, Shillington Borough, Spring Township, and Wyomissing Borough. This pump station does not have an overflow or bypass pipe.

The present pump station consists of an automatic screening system with a bypass to a manually cleaned screening basket and a two compartment wet-well. There are four 250 hp, 5208 gpm dry pit submersible pumps with only three being connected to controls and one in-line spare. The control system is a state of the art electronic system that can be monitored and controlled remotely through the SCADA system. There is a flow meter, an automatic emergency generator and a backup automatic alarm dialer system to call the emergency phone numbers.

Following are the presentation categories for the WWOP for the 18th Ward Pump Station.

- A. History, Coordination, Cross References, Evaluations and Experiences
- B. Flow Maximizing Strategy Development

- C. Implementation, Training and Safety
- D. Process Monitoring and Data Compilation

A. History, Coordination, Cross References, Evaluations and Experiences

The 18th Ward pump station was originally constructed in this location in the 1950's as the City expanded its limits and sanitary sewer system as well as in response to sewer needs due to suburban growth. The original station was last upgraded in 1992. It had an unmonitored gravity overflow pipe to the Schuylkill River and lacked an emergency generator. As such, overflows frequently occurred during power outages but were only discovered after the return of power upon physical inspection of the station. It has been reported that on some occasions, the station was discovered to be in an unexpected overflow situation when routine maintenance inspections were performed. The station overflows were discovered at other times based upon reports of sanitary sewer overflows in the tributary interceptors.

In 2002, upgrades were underway to replace the main interceptor to the pump station and a new pump station was being constructed. The pump station pumps of 75 hp, 2000 gpm at 93 feet TDH were replaced with pumps that are 250 hp, 5208 gpm at 120 feet TDH thereby significantly increasing the pump station's pumping capacity. The new pump station which went on-line in March 2003 includes an automatic emergency generator and is connected to the City's SCADA system for monitoring and control. Additionally, the new station construction included the elimination of the gravity overflow pipe. The former Philadelphia Suburban Water tracked the station performance closely as the discharge of raw, untreated wastewater impacted their water treatment facilities. Additionally, the Philadelphia Water Department's source water protection program targeted the elimination of raw wastewater discharges into the Schuylkill River. Since the new pump station's construction, there have been no overflows.

B. Flow Maximizing Strategy Development

The recent replacement of this station including the removal of the overflow piping and installation of the emergency generator has addressed any high flow problems. Therefore, this pump station no longer has a history of high flow event problems, nor is it at risk of experiencing problems based on our in-house evaluation.

Our standard practice is to use the fourth dry pit submersible pump in the event one of the three on line pumps experiences a failure during a High Flow event. This fourth pump is an installed standby/spare part that was not hardwired and did not have a control panel. However, it failed to rotate when needed as a spare part during maintenance of an on line pump. Therefore, we elected to connect a VFD control with temporary wiring so routine exercising is possible and this fourth pump is available standby/spare part use when needed.

C. Implementation, Training and Safety

Described below is the **WWOP Schedule for Implementation** for the 18th Ward Pump Station items that are ongoing and/or planned.

Prepare and implement SOP

A consolidated High Flow SOP will be prepared. Presently there are various related SOPs and standard practices (SPs) in use.

SCADA control updates

We will be evaluating and expanding the SCADA system's ability to control the Sixth and Canal PS from remote locations.

D. Process Monitoring and Data Compilation

If an emergency overflow is noted then samples will be collected in the collection system prior to the station and analyzed for certain conventional permit parameters.

V. West Reading Pump Station

The West Reading Pump Station is a small package pump station serving a few homes in a low lying area of the 18th Ward. It pumps to an interceptor leading to the 18th Ward Pump Station.

The package pump station consists of two 3 hp, 65 gpm pumps, a basic control system, an automatic emergency generator and an automatic alarm dialer system to call the emergency phone numbers. There is no bypass or overflow pipe present at this site.

Following are the presentation categories for the WWOP for the West Reading Pump Station.

- A. History, Coordination, Cross References, Evaluations and Experiences
- B. Flow Maximizing Strategy Development
- C. Implementation, Training and Safety
- D. Process Monitoring and Data Compilation

A. History, Coordination, Cross References, Evaluations and Experiences

This pump station was originally constructed in the 1960's with the last upgrade in 1991. It does not have a history of high flow event problems, nor is it at risk of experiencing problems based on our in-house evaluation.

B. Flow Maximizing Strategy Development

Our standard plan as a backup is to use the City's two flusher-vacuum trucks to control the wet-well level in the event this pump station ever experiences an unforeseen high flow problem.

C. Implementation, Training and Safety

Described below is the **WWOP Schedule for Implementation** for the West Reading Pump Station items that are ongoing and/or planned.

Prepare and implement SOP

We will be preparing a High Flow SOP.

Monitor for I&I

On an ongoing basis the City evaluates the monthly pump station pumping hours to determine when there is a need to assess and address I&I for this small service area.

D. Process Monitoring and Data Compilation

No monitoring necessary. If an emergency overflow is noted, then samples will be collected and analyzed for certain conventional permit parameters.

VI. Fritz Island Grit Chamber

The Fritz Island Grit Chamber (FIGC) facility serves the 18th Ward Pump Station, portions of a City gravity system down stream of the 18th Ward Pump Station force main discharge, parts of Kenhorst Borough and parts of Cumru Township. The FIGC discharges through two parallel, gravity, pressure lines that combine together on the WWTP site before flowing through a magnetic flow meter. There is also a gravity sewer from Cumru Township and a pump station force main with flows from Cumru and Robeson Townships that discharge into these parallel pressure lines following the FIGC before the diversion box for the primary clarification process at the WWTP.

The facility consists of a mechanical bar screen with a manual bar screen bypass channel, a grit removal facility and discharge distribution chamber. The FIGC functions as one of the two headworks for the WWTP by providing preliminary treatment. There is also a high flow bypass from an overflow chamber upstream of the grit chamber that discharges into the discharge distribution chamber during severe high flow events. There is an automatic alarm dialer system to call the emergency phone numbers.

Following are the presentation categories for the WWOP for the FIGC.

- A. History, Coordination, Cross References, Evaluations and Experiences
- B. Flow Maximizing Strategy Development
- C. Implementation, Training and Safety
- D. Process Monitoring and Data Compilation

A. History, Coordination, Cross References, Evaluations and Experiences

The grit chamber is located in the area where the original WWTP was constructed in the mid-1890's. This facility was originally constructed when the City sewered the tributary service area. Upgrades were done to this facility when the 18th Ward Pump Station replacement was

done. A bypass line around the FIGC's bar screens and grit chamber was constructed to handle high flows in excess of the facility's capacity to convey excess flows directly to the automatic valve discharge chamber. The FIGC 30-inch discharge, pressure pipe was replaced with a 36-inch pipe. The 36-inch pressure pipe parallels the preexisting 20-inch discharge, pressure pipe to the Fritz Island WWTP site.

Due to the age of facilities at this site, there were some undocumented pipes discovered during construction. One of these was in the facility's discharge vault. Upon the site development of KVP at the original WWTP site, this higher elevation, smaller diameter pipe was unknowingly severed and became an overflow into the building site on two wet weather occasions during July 2004. At that time, the pipe was capped to prevent future overflows into the newly-developed industrial site. Based on this discovery, City personnel surmised that the FIGC site may have had numerous undetected overflows in the past into the wooded, overgrown former WWTP site which still contained abandoned treatment units.

During an October 2005 high flow event the FIGC experienced an overflow, along with one (1) minor overflow events since that date. We made site improvements and implemented standard practices as part of developing wet weather procedures. The standard practices will be performed on a recurring basis under normal operating conditions so that flow maximization will occur during a high flow event.

Further investigation and evaluation of the FIGC's hydraulic limitations and recommended solutions is a part of the WWOP. What future FIGC modifications will be implemented are dependent upon the ultimate headworks location (s) for the WWTP.

B. Flow Maximizing Strategy Development

Assuring the overflow chamber for the FIGC bypass is clean and that the pressure lines from the FIGC to the WWTP are clear of debris for maximum flow capacity are two standard practices that have been implemented.

C. Implementation, Training and Safety

A step taken in implementing the Interim Wet Weather Operating Strategy (IWWOS) is the standard practice of routinely inspecting, cleaning, and flushing the storm flow diversion chamber that diverts excess flow around the FIGC, along with and the associated sanitary sewer lines. We also automated the discharge gates at the FIGC so they assure routine flushing of each pressure line to the WWTP. The flushing of the pressure lines maximizes the lines' capacity for high flow events.

Additionally, we had prepared a standard practice under the IWWOS for testing at the WWTP to bypass the primary clarifiers' effluent to the Secondary Trickling Filters Distribution Box. This would reduce the head level in the primary clarifiers and their distribution box while simultaneously reducing the head level at the FIGC and reducing the

risk of overflows. If needed at a later date, this IWWOS standard practice that was previously prepared will be tested and possibly implemented if practical.

Instead, our ongoing investigations revealed better steps to implement first. The throttled feed valve to Primary Clarifier #4 is fully opened during a high flow event and there was a corrective action taken to fully open a buried primary clarifiers' discharge valve that was throttled. Both these steps helped lower the Primary Clarifiers Distribution Box level during high flow events, and thus also lowered the FIGC level.

Recurring work orders have been entered into the Antero computerized maintenance management system (CMMS) to assure the FIGC bypass flushing and the automatic gate operation standard practices occur during normal operations. Additionally, there was the simultaneous automation to open both FIGC discharge gates for the pressure lines in the event of a high flow to assure maximum capacity.

Described below is the **WWOP Schedule for Implementation** for the Fritz Island Grit Chamber items that are ongoing and/or planned.

- Evaluate discharge pipes hydraulic capacities

 - A hydraulics engineer started evaluating the hydraulics limitations on the two (2) pressure lines that discharge from the FIGC to the WWTP. The engineer started this and other WWOP related evaluations on April 30, 2007.

- Prepare and implement SOP

 - We will be preparing a High Flow SOP.

- Install SCADA monitoring and control

 - The FIGC operations will be linked into the SCADA system for remote monitoring and control of critical FIGC components.

D. Process Monitoring and Data Compilation

Daily composite and grab samples are taken at the Fritz Island Grit Chamber and analyzed for certain conventional permit parameters such as BOD5, pH, Ammonia and TSS. If and emergency overflow is noted then samples will be collected and analyzed for certain conventional permit parameters.

VII. Wastewater Treatment Plant (WWTP)

The 28.5 MGD average daily flow and 42.75 peak daily flow rated WWTP receives waste from four separate areas: the Sixth and Canal Pump Station, the Fritz Island Grit Chamber, a remote Cumru Township pump station with Robeson Township flows, and a gravity service line from Cumru Township.

The WWTP process consists of primary clarification, primary trickling filtration, intermediate clarification, intermediate pumping, secondary trickling filtration, tertiary pumping, tertiary clarification, tertiary submerged media treatment, final clarification and chlorination/de-chlorination. The effluent flows to the Schuylkill River by gravity to a submerged outfall. There

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are two parallel influent and four parallel effluent flow meters and various overflows and/or gated bypasses between the various processes; however, there are no direct overflows or bypasses to the Schuylkill River. All wastewater that is treated or partially treated passes the effluent sampler and parallel effluent flow meters and is therefore properly monitored and measured as a weighted average within the combined WWTP effluent flow. Please see the WWTP Liquid Process Flow Schematic in Appendix D.

Solids removed from the clarifiers are blended in a sludge mix tank and then thickened on gravity belt thickeners (GBT). The thickened sludge from the GBT discharges to the three primary anaerobic digesters. This is followed by digestion in two secondary anaerobic digesters and dewatering on four belt filter presses. The final product is presently hauled to landfills for disposal and the removed filtrate and supernatant is returned to the head of the WWTP. Critical components of the solids treatment processes are monitored and/or controlled by the WWTP SCADA system.

The Intermediate Pump Station has seven 75 hp, 4250gpm submersible pumps with variable frequency drive (VFD) controls that vary pump speed based upon a level sensor. Some of the pumps can be used for primary trickling filters' recirculation or forward flow, pending the flow to the WWTP. The Tertiary Pump Station has four 100hp, 7425 gpm submersible pumps with VFD controls off a level sensor. Both these internal pump stations are monitored and controlled by the WWTP SCADA system.

Following are the presentation categories for the WWOP for the WWTP.

- A. History, Coordination, Cross References, Evaluations and Experiences
- B. Flow Maximizing Strategy Development
- C. Minimizing the Washout of Solids
- D. Implementation, Training and Safety
- E. Process Monitoring and Data Compilation

A. History, Coordination, Cross References, Evaluations and Experiences

The WWTP was constructed on the opposite side of the Angelica Creek in the late 1920's. At that time, the primary clarification and solids digestion occurred near the current FIGC site with the addition of biological treatment, final clarification, and disinfection occurring at the current WWTP site with the wastewater flows in the WWTP being completely by gravity. The WWTP was upgraded again in the late 1950's with all facilities constructed on Fritz Island and reuse of a prior clarifier in the upgraded facility. At this time, what is now known as the intermediate pump station was constructed for forward flow pumping. The WWTP's rated capacity reached its current capacity during a 1988 upgrade which added an additional stage of biological treatment and another forward flow pump station known as the tertiary pump station. During each of these two upgrades, alternate flow pattern valving was added to accommodate moving wastewater during high flow events.

Historically, the WWTP did not experience wet weather overflows due to capacity and overflow problems at other tributary locations. These problems limited the volume of

wastewater received at the WWTP. The recent upgrades in the collection system mechanicals and control systems have increased the wet weather flows received at the WWTP. As such, overflows were initially from individual treatment units and remained in the facility. Gradually, plant staff began working to address the operational, mechanical, and electrical maintenance to increase the volume of wastewater able to be fully treated at the WWTP.

A hydraulics engineer was contracted to evaluate the two internal pump stations. The engineer's report is included in Appendix E. During the high flow events within the past year we learned how to greatly increase the WWTP internal pumped flow without bypassing or overflowing between processes. Additionally, staff built upon the foundation of the engineer's findings to greatly improve forward flow capability by using some revised standard practices, purchasing some additional valve operating equipment and increasing the Tertiary Pump Station pumping capacity.

These improvements have had a major impact on the WWTP forward flow capability resulting in an improved maximum flow capacity through the WWTP. In the past, the high flow procedure for relieving flow restrictions began at approximately 24 MGD, which is less than the rated daily capacity of the WWTP. The flow rate for relieving restrictions is now 57 MGD approximately, considerably more than the 42.75 MGD peak daily flow rating of the WWTP.

In June 2006 there was an external flooding event that was labeled as the third worst in Reading's recorded history. The Schuylkill River backed through the outfall and caused WWTP flooding of the intermediate clarification, final clarification and chlorination/de-chlorination processes. This event warranted evaluation of preventive measures for reducing the impact of the river flooding the WWTP by backflowing through the outfall.

B. Flow Maximizing Strategy Development

The WWTP SCADA system has been upgraded to better control both WWTP internal pump stations to maximize flow and minimize bypasses and overflows between processes. Additionally, we purchased an additional, electric powered valve operator and strategically located the valve operator near the Intermediate Pump Station so it can be used to quickly switch the recirculation flow pumps to forward flow.

Major repairs to the Tertiary Pump Station addressed pumping capacity limitations. These repairs coupled with recurring, preventive maintenance work orders within the Antero CMMS assure reliable pump operations were another step of our IWWOS. Additionally, another pump was added in the fifth open pump slot to increase pumping capacity.

Ongoing refinement of the Storm Flow SOP for the Wastewater Treatment Plant includes, where applicable, the throttling of some process control valves to avoid treatment unit overflows and the full opening of other process control valves to eliminate the restriction of capacity. The locations of these valves are Primary Clarifier #4, Intermediate Clarifier #2

and Tertiary Clarifier #2. Additionally, we located an inappropriately throttled underground Primary Clarifiers' discharge valve that is now fully opened. Another addition is the step(s) we are taking to assure there is no solids washout from the tertiary process now that additional forward flow can be passed through this process.

The hydraulics engineer was again contracted to evaluate existing facilities to determine standard practices that may minimize the likeliness of a recurring Schuylkill River backflow event and/or minimize damages and losses in the event other river backflow event occurs. He assessed if there are any practical, short-term improvements to prevent river backflow and allow for effluent pumping during that time. A previous feasibility study and preliminary design of an effluent pumping station is the basis from which the hydraulics engineer worked. Please see Appendix F for a copy of the hydraulics engineer's report on effluent pumping.

If necessary, the City will address the long-term effluent pumping needs in the designing and locating of the future WWTP structures with the goal of having all WWTP facilities situated to prevent the Schuylkill River backflow impacts.

C. Implementation, Training and Safety

The Storm Flow SOP for the Wastewater treatment Plant uses the recently purchased and strategically located electric powered valve operator to assure a quick response to high flow events. It allows for switching of the Intermediate Pump Station recycle pumps to forward flow pumps without delay. Other refinement of the Storm Flow SOP for the WWTP includes, where applicable, the throttling of some process control valves to avoid treatment unit overflows and the full opening of other process control valves to eliminate the restriction of capacity. The locations of these valves are Primary Clarifier #4, Intermediate Clarifier #2 and Tertiary Clarifier #2. Additionally, we located an inappropriately throttled underground Primary Clarifiers' discharge valve that is now fully opened. Another addition is the step(s) we are taking to assure there is no solids washout from the tertiary process now that additional forward flow can be passed through this process. Please refer to Appendix G for the complete Storm Flow SOP for the Wastewater Treatment Plant.

An in-house assessment and associated preventive maintenance practices revealed some major Tertiary Pump Station repairs were necessary in order for the pumps and pump station to operate at capacity. A combination of staff and contractor repairs has greatly increased the Tertiary Pump Station performance and assures maximized forward flow. Follow-through with Antero CMMS recurring work orders assures the preventive maintenance for these pumps and avoids a recurrence of the failures. Keeping continuous, normal operations of the pumps also assures the maximization of flow during high flow events. Additionally, another pump was added in the fifth open pump slot to increase pumping capacity. This fifth pump is a manually operated, fixed speed pump for use only during storm flow events.

A hydraulics engineer has evaluated economical, short-term options to a previous feasibility study and preliminary design of an effluent pumping station, and the City will consider

phasing in any practical, short-term option of an effluent pumping station. Presently the WWTP appears to marginally meet PaDEP guidelines for operation under flood conditions. For the long-term solution of the river backflow, the new WWTP site layout has a goal of eliminating treatment units from lower areas that are prone to river flooding.

Described below is the **WWOP Schedule for Implementation** for the Wastewater Treatment Plant items that are ongoing and/or planned.

Evaluate WWTP maximum hydraulic load

A hydraulics engineer is evaluating the maximum hydraulic load to the WWTP, including the pressure lines that discharge from the FIGC, the 6&CPS force main, the Cumru gravity sewer and the Flying Hills Pump Station force main. The engineer started this and other WWOP related evaluations on April 30, 2007.

Storm Flow SOP Contingency Plan for the WWTP

Due to the sensitivity of the WWTP maximum flow capacity we are planning to prepare a contingency plan that will address response steps to take in the event a critical WWTP component (components) fails during a storm/high flow event.

D. Minimizing the Washout of Solids

Improved normal operation of the WWTP processes has reduced the solids inventory within the treatment units and therefore nearly eliminated the risk of solids washouts. Processes reassessment is practiced with updates of the Storm Flow SOP for the WWTP to assure the solids washout control is not jeopardized.

A recent storm flow event probably resulted in some solids washout of tertiary and/or final solids. This was potentially caused by increasing the Tertiary Pump Station capacity under the IWWOS and sending more flow through the tertiary process than was possible before. This tertiary process flow maximization resulted in a possible aeration tanks' and or final clarifiers' solids washout. The Storm Flow SOP for the WWTP is being assessed and is being modified to address this potential problem. Balancing flow maximization with simultaneous solids washout minimization is a challenge we are and will continue to address.

E. Process Monitoring and Data Compilation

Locations sampled at the WWTP on Fritz Island are representative of the complete process as documented in previous Consent Decree submittals from the City to the US Department of Justice, US EPA and PaDEP. Composite and grab samples are collected daily at all locations and analyzed for certain conventional permit parameters as well as other process control testing. If an internal, emergency overflow or bypass is noted, then samples will be collected and analyzed for certain conventional permit parameters.

VIII. General Practices

The general practices that we have implemented under the IWWOS and are continuing under the WWOP include a process of holding briefings and debriefings for storm and high flow events.

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The debriefings include the documenting of a things-to-do list that will refine the SPs and SOPs for the future, along with corrective action and improvement work orders to fortify prevention, response and recovery efforts.

We have already and continue the installation of additional SCADA work stations to improve management, operation and maintenance (MOM) flexibility and control. Stations are planned for strategic locations that will assure continued emergency operations during severe flooding and or high flow events.

Following are the presentation categories for the WWOP for the General Practices.

- A. History, Coordination, Cross References, Evaluations and Experiences
- B. Flow Maximizing Strategy Development
- C. Implementation, Training and Safety
- D. Process Monitoring and Data Compilation

A. History, Coordination, Cross References, Evaluations and Experiences

The City is continuing to improve our responsiveness to regulations and expectations. We have hired a team of professionally minded managers and supervisors to help us move forward. Additionally, these professionals are implementing management practices and systems to help the entire team improve their professionalism, and thus the overall responsiveness to regulations and expectations.

Incorporating SCADA monitoring into the WWOP delivers real time information to the supervisors and operators in easily accessible locations and in a format that helps them to make sound decisions during abnormal operating conditions. The SCADA automation takes corrective action and makes preprogrammed adjustments as needed to assure flow maximization. Additionally, automated high flow SCADA responses and corrective actions free the operators from specific monitoring and response steps and this allows them to monitor and address non-routine issues that occur.

Developing these General Practices under this WWOP and the preceding IWWOS are examples of the steps being taken in our overall MOM Plan.

B. Flow Maximizing Strategy Development

Implementing the General Practice of holding briefing and debriefing sessions including the creation of a things-to-do list helps us to be better prepared for the next event and provides ongoing improvements based on recent experience. Preparedness assures maximization of flow.

C. Implementation, Training and Safety

It was an intentional decision to implement the process of holding briefings and debriefings for storm and high flow events including the creation of things-to-do lists. This decision by

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management is a part of the overall MOM Plan. The WWTP management and supervisor team have been trained in this General Practice process in leadership training and through the participation in actual briefing and debriefing sessions.

Described below is the **WWOP Schedule for Implementation** for the General Practices items that are ongoing and/or planned.

Annual WWOP Review

The reminder for this activity will be entered into the existing Antero computerized maintenance management system (CMMS) before May 30, 2007.

Flood Response/Remediation/Recovery SOP

An SOP will be created that will consolidate the existing standard practices that address flood events.

The WWOP shall adequately address any comments from EPA and PADEP on that wet weather operational strategy.

To date, the City has not received any comments on the IWWOS from EPA or PaDEP. The City recognizes EPA and PaDEP expect the City to address any of the comments by EPA and PaDEP regarding the IWWOS. The City will incorporate these comments into the Wet Weather Operation Plan (WWOP) as appropriate, and the WWOP shall be more comprehensive than the IWWOS.

The WWOP includes formalized SOPs that are/will be prepared based from the standard practices created during the preparation and implementation of the IWWOS. The standard practices are not as formal and are less refined. SOPs also can/will go through an updating process that is referred to as "revisions".

The building and updating of the IWWOS into this WWOP has created noticeable improvements and successes throughout the City's wastewater locations and sites. Following is a summary of the improvements resulting from the IWWOS.

- Collection System – The pump station improvements and interceptor replacement discussed have had any system problems migrating toward the WWTP. Increasing employee awareness to this change has increased awareness to potential SSO problems and improved response with the future elimination of the problem now seen as a possible goal. Most of the former problem areas have been greatly reduced if not eliminated.
- Sixth and Canal Pump Station – Increased pumping capacity, maximized high flow retention through implementing standard practices and minimized bypassing through management controls.
- 19th Ward Pump Station – Improved awareness of overflow risks, actual monitoring/measuring/documenting of overflows, and creation of standard practices to assure flow is maximized and bypasses are minimized and recorded.
- 18th Ward Pump Station – Increased pumping capacity, removal of overflow piping and continuous, real time SCADA monitoring/documentation. Also, the creation of a backup plan in the event a high flow problem occurs.

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- West Reading Pump Station – Creation of a backup plan in the event a high flow problem occurs.
- Fritz Island Grit Chamber – The Storm Flow Diversion Chamber that diverts flow around the FIGC reduced the risk of collection system overflows. There were several FIGC standard practices implemented to prevent and control overflows.
- Wastewater Treatment Plant (WWTP) – Improved storm flow and high flow standard practices and SOP, improved control of internal pump stations through SCADA programming and some pump stations' repairs/improvements have maximized the forward flow capacity from 24 MGD to +/- 57 MGD. Improved normal operation of the WWTP processes has reduced the solids inventory within the treatment units nearly eliminating the risk of solids washouts.
- The General Practices that we implemented help us to prepare for, respond to and recover from storm and high flow events.

These noticeable improvements and successes form the foundation that will continue to be built on to assure the comprehensive long term WWOP maximizes compliance.

The WWOP shall also provide for and include a log of any SSO events which identify the nature of the storm events, the locations of the SSO discharges, and the duration and estimated volume of the SSO discharges.

The City reports any SSO events that may occur to the PA DEP with notification upon discovery or knowledge of the situation. Depending upon the severity of the problem, PA DEP may require a written report providing more detailed additional information. These letter reports include at a minimum: date, time, location, estimated duration and volume of discharge, surrounding circumstances, and potential causes of the event. In addition to being mailed to PA DEP upon the completion of the investigation, these written reports are included in the annual Chapter 94 report to PA DEP.

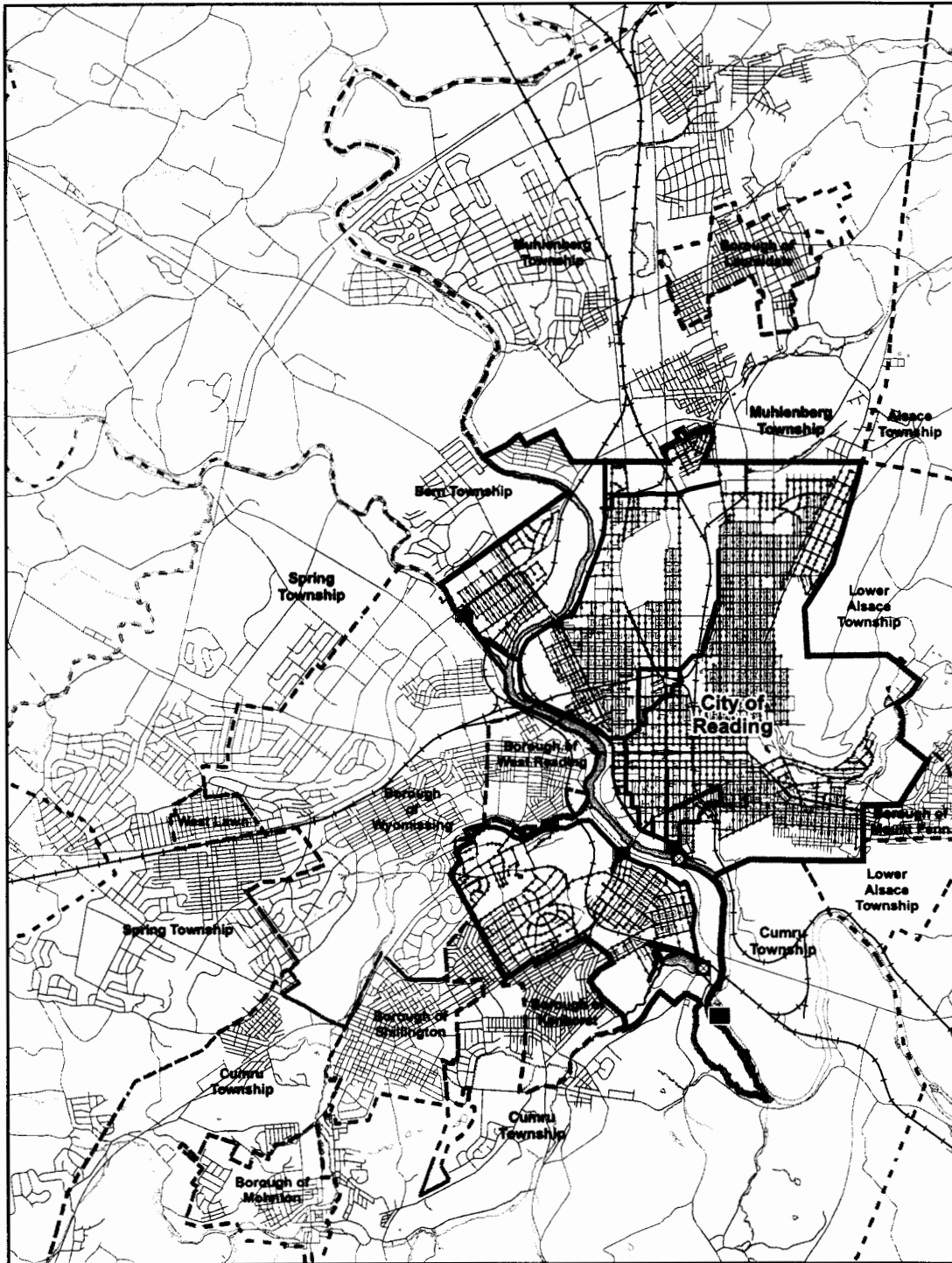
Based on the minimal amount of recent overflow events, the City has not designed a separate log sheet for SSO discharges but rather maintains the letter reports as a reference file. Upon identification of potential bottlenecks through the system flow modeling discussed above, additional areas will be identified to be included in the preventive maintenance system inspections and for potential SSO event monitoring. If this yields an increase in the number of SSO events, the City may implement a different recordkeeping method.

Upon approval from EPA & PADEP, the Defendant shall implement the WWOP.

The City is already utilizing and continuously improving this WWOP. We will fully implement the WWOP revisions based on comments from EPA and PADEP once comments are received. The City has been utilizing the SOPs and standard practices within this WWOP as it is being built on and as we updated the Interim Wet Weather Operational Strategy of this Decree. The City will continue to build on and update this WWOP as we learn from high wastewater flows and external flooding during wet weather events.

Appendix A

City of Reading Sanitary Sewer Service Area



Legend

- WWTP
- ⊠ WWTP Headworks
- Pump Station
- Manhole
- Interceptor Sewer
- Gravity Sewer
- Force Main
- City Boundary
- Satellite Service Area



0 2,500 5,000 Feet

City of Reading
Wastewater Treatment Plant
Sanitary Sewer Service Area
City of Reading and Contributing Municipalities



BLACK & VEATCH
building a world of difference™
ENERGY WATER INFORMATION GOVERNMENT

PRELIMINARY

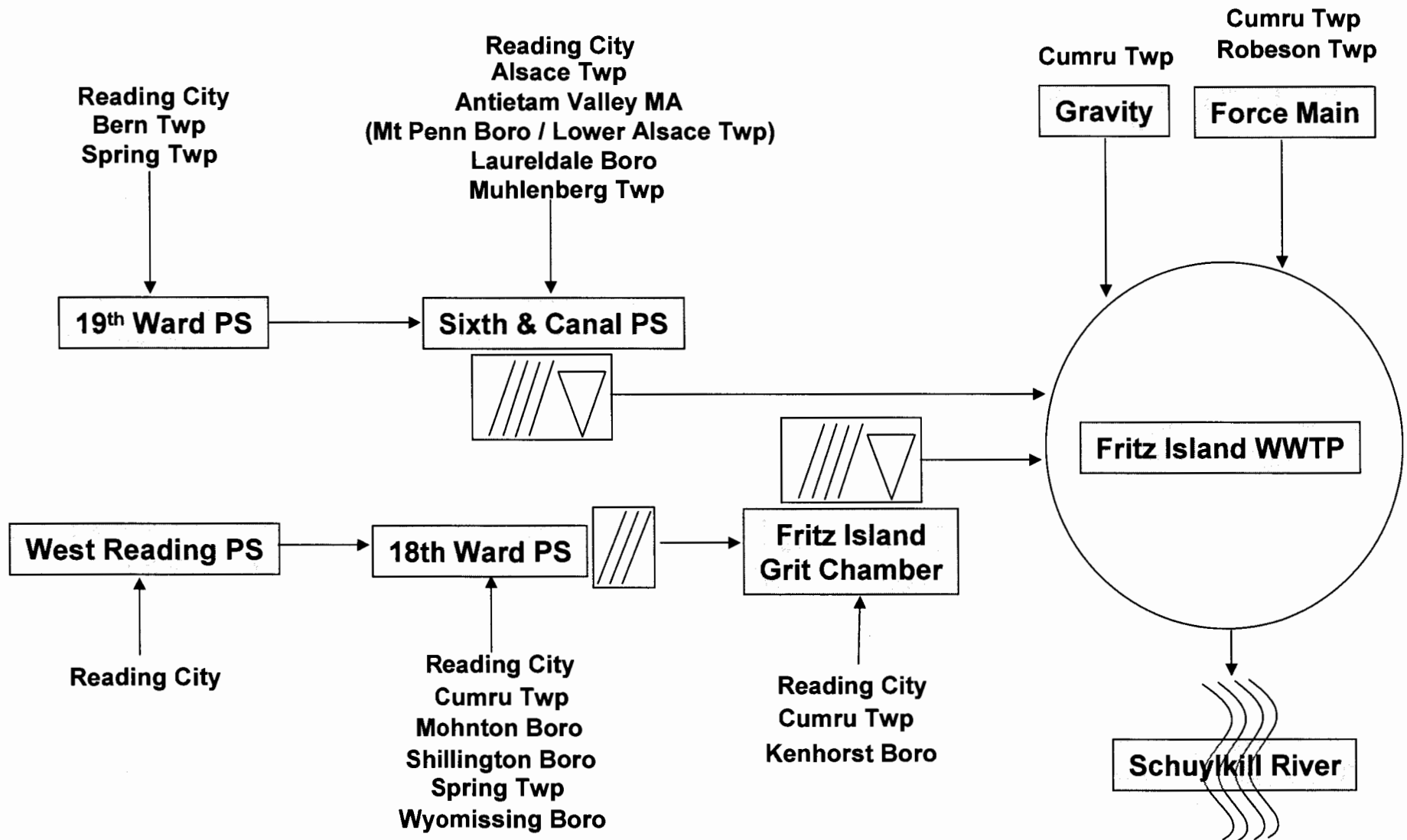
Appendix B

Sanitary Sewer Collection System Wastewater Treatment Plant Tributary Flow Schematic

City of Reading

Sanitary Sewer Collection System

Wastewater Treatment Plant Tributary Flow Schematic



Appendix C

19th Ward Pump Station Three (3) Engineering Evaluation Reports

DOUGLASS MCGILL, P.E.

2807 Fisherville Road
Coatesville, PA 19320

October 24, 2006

Ralph E. Johnson
Superintendent of Wastewater
City of Reading
815 Washington Street
Reading, PA 19601

RE: 19th Ward Pump Station

Dear Mr. Johnson:

On October 3, 2006, you, Bob Gensemer, and I re-examined the overflow connection at the 19th Ward Pump Station as the result of an overflow to the Tulpehocken Creek on September 28, 2006. We re-examined the entire 19th Ward Pump Station operational procedure and details of the overflow piping to the Tulpehocken Creek at the station.

On June 3, 2006 we also had an overflow at the pump station and at your request I made an estimate of a total release to the creek at between 202,000 GPM and 252,00 GPM. The June estimate was based on several assumptions. The overflow time frame was very arbitrarily based on the metered pump station discharge charts, which are only an indication of a possible overflow.

The flow chart for the September 28, 2006, event coincidentally showed an exact same two-hour multi-pump operation, as did the June event flow chart. Our close inspection showed that the 12-inch PVC overflow outfall pipe in a concrete head wall was severely embedded and restricted by consolidated materials, which could not be shoveled or pried out. This left only a small segment of pipe open for a discharge. In the June 2006 calculation, we assumed the materials around the pipe washed free and that the outfall pipe was freely discharging. I am now certain that the overflow outfall was very restricted both times. The exposed open pipe segment could be considered a part of an open gate valve or an irregular orifice in calculations to estimate overflow rates. Observation of the elevation of debris in the "Tide Flex" valve manhole just upstream of the discharge point established the peak head condition used in calculating peak flow rates.

I believe the level in the Tulpehocken Creek was below the open segment of the outfall both times so I computed the peak flows assuming the 12" PVC outfall pipe was flowing full and was freely discharging through the segment ("orifice"). The peak flow is then approximately $Q = AC\sqrt{2gh}$.

Typically a flow coefficient "C" for a rough round orifice such as might be about 0.5 – 0.6. Since the open segment an irregular shape with a rough bottom, the coefficient is more likely to be in the 0.45 – 0.55 range. The maximum measured head was about five feet for the October event

based on observed debris in the Tideflex manhole. The open area of the orifice "A" was estimated to be about 0.3 sq. ft.

$$\text{Peak flow} = (0.3)(0.5)(\sqrt{2g \times 5})$$
$$(g=32.2)$$

Peak Q = 2.69 CU. FT./SEC or 1208 GPM

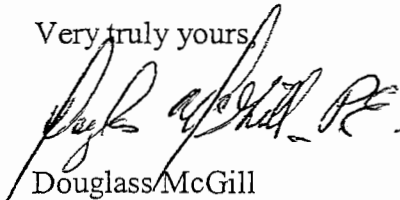
Using an assumed 90 minute total overflow period and an average flow of one half the calculated peak flow, for the two-hour duration, I calculated an estimated total overflow release for the October event as follows:

$$\frac{1208}{2} \times 90 = 54,360 \text{ gallons}$$

While we did not have a measurement of maximum head in the "Tide Flex" manhole in the June event, I would estimate that the June event had about the same conditions based on elevations observed in the wet well. I estimate that the total release for the June event was more like the 54,000 gallons rather than the 202,000 gallons to 250,000 gallons I previously calculated when I was not aware of the restriction blocking the outlet pipe.

Please call if you have any further questions.

Very truly yours,



Douglass McGill

Douglas L. McGill, P.E.

Consulting Engineer
2807 Fisherville Road
Coatesville, Pa. 19320
610-380-1412

City of Reading
815 Washington Street
Reading, PA 19601
Subject: 19th Ward Pumping Station

July 2006

ATTN: Ralph E. Johnson, Plant Superintendent

Dear Mr. Johnson,

Per your request I have estimated that the sewage overflow discharge to the Tulpehocken Creek at the pump station was approximately 200,000 – 250,000 gallons on June 3, 2006.

Examination at the overflow pipe at the head wall and inspection of evidence of debris in the wet well level markings in the 19th Ward pump station clearly indicates an overflow occurred. From the pump station discharge flow meter chart it can be deduced that the overflow occurred during the two hour period in which the pump discharge meters recorded multiple pumps running. Frankly I had to guess at the actual overflow period since there is no instrumentation in place at this time to measure the time frame, let alone the flow.

Examination of grease and debris levels in the wet well showed that the level reached about elevation 195.5. Assuming the liquid elevation in manhole No.1 was about the same as the wet well the peak overflow rate during the storm event was calculated to be between 4500 and 5600 GPM. The head above the centerline of the 12 in. overflow pipe was approximately $(195.5 - 190.5) = 5\text{ft.}$

Douglas L. McGill, P.E.

Consulting Engineer
2807 Fisherville Road
Coatesville, Pa. 19320
610-380-1412

Since the intense storm was relatively localized and of short duration, I assumed the discharge was free and not submerged by the Creek during the event. I also assumed that the head loss caused by the Tideflex check valve was minimal based on discussions with "Rel Valve Co.".

Treating the 12 in. outfall pipe as a culvert with a free discharge I estimated peak overflow of 10 CFS or 4500 GPM. If the outlet were back flooded I got almost the same value. Treating the outfall as a short tube per "King" I calculated about 12 CFS for the peak flow using the following formula:

$$\begin{aligned}\text{Flow} &= \text{Area} * \text{coefficient} * \sqrt{2gh} \\ \text{where area} &= 0.785 \text{ sq. ft.} \\ \text{coefficient} &= 0.7 \text{ (Estimated)} \\ \sqrt{2gh} &= \sqrt{2 * 32.2 * 5} = 12 \text{ CFS} \\ \text{Peak Flow} &= 5600 \text{ GPM}\end{aligned}$$

For the period of overflow actually occurring I assumed that the overflow started about 15 minutes after the second and third pumps started as indicated by the flow chart. The flow rose to the peak and then tapered off until the pumps were carrying the entire load

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Consulting Engineer
2807 Fisherville Road
Coatesville, Pa. 19320
610-380-1412

15 minutes before the two hour period ended for a total time of 1.5 hours where the overflow occurred. I assumed the flow rose to the peak rapidly and then tapered to zero, uniformly.

The total estimated flow is calculated by integration of the area of a triangle with an altitude of peak flow and a base of 1.5 hours or 90 minutes:

CASE I	$\frac{(4500)(90)}{(2)} = 202,000 \text{ Gal. Estimated Discharge}$
CASE II	$\frac{(5600)(90)}{(2)} = 252,000 \text{ Gal. Estimated Discharge}$

Please realize that the peak overflow rate estimate is not the total peak flow. The output of the pumps should be added. This would give a total peak flow of 6,000 – 7,100 GPM. during that instant.

If you have questions or wish to discuss, please call.

Very Truly Yours,

Douglass L. McGill, P.E.

Douglas L. McGill, P.E.

Consulting Engineer
2807 Fisherville Road
Coatesville, Pa. 19320
610-380-1412

City of Reading

November 2006

ATTN: Ralph E. Johnson, Plant Superintendent

Dear Mr. Johnson,

This letter report summarizes my findings and opinions regarding the Wet Weather Operational Plan and Minimization of Sewer System Overflow Events of 19th Ward Pump Station.

Summary of current overflow events to the Tulpehocken Creek at the existing 12" overflow pipe tied to the inlet manhole and to the pump station wet well:

1. Since close observation was initiated two (2) overflow events have been substantiated. Total releases of about 50,000 gallons each have been estimated. These events were on June 2, 2006 and September 28, 2006.
2. Discharge flow measurements indicate that the three (3) parallel pumps discharge the following:
 - Lead pump only 2.17 MGD (1506 GPM)
 - Lead and Lag pump running 2.94 MGD (2041 GPM)
 - Lead, Lag and spare pump running 3.30 MGD (2291 GPM)
3. By examination of the station discharge flow charts from August , 2004 through September, 2006 it has been observed that one (1) pump carried the total flow 99.91 % of the time. (See Appendix #1)

These charts show that more than the lead, lag and probably the spare pump operated a total of less than seventeen (17) hours during the time period examined. As indicated in point one (1) it is known that an overflow occurred

twice during that period. There is a possibility, but not a certainty that an overflow occurred each time more than one pump operated. This results in a worst case scenario of less than seventeen (17) hours of possible total overflow time out of 18,984 operating hours. (0.09 % of the examined time period)

4. The total number of times more than one (1) pump operated during the period examined was eleven (11). Length of time per event varied from ten (10) minutes to seven (7) hours. Total possible overflow time was less than seventeen (17) hours. (See appendix 1)

Opinions of the Engineer for future possible overflow conditions:

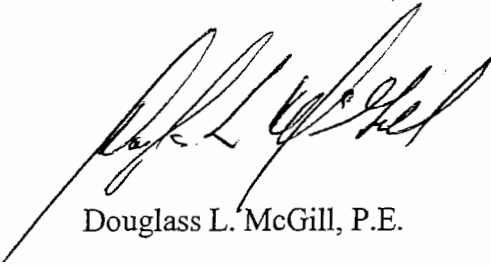
As the townships grow and piping systems deteriorate with time the peak flow events will probably increase unless a successful I & I reduction program is achieved. Any pump station or facility like the 19th Ward pump station is designed to meet a certain peak flow. Above that flow an overflow condition will occur. Many sewer collection systems installed since Hurricane Agnes and the later development of the 100 year flood elevation by FEMA have or will overflow eventually. Good practice deals with the frequency and probability, not elimination of overflows. The computed overflow frequencies and quantity at the 19th Ward pump station at this time are not totally unreasonable in my opinion and should be discussed with the EPA and DEP prior to expending large sums of money now to reduce the possible overflow time down from 0.09% to 0.01%.

Corrective steps – Options – 19th Ward Pump Station:

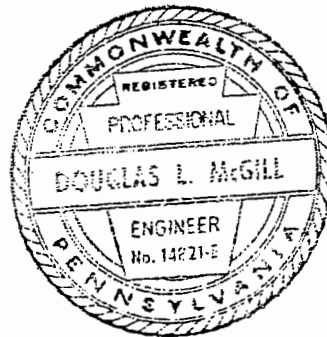
1. Provide for measurement and detection of overflow events by installation of a level indicator with transmission of information to management. This could be done until a new station is required. (See Cost Estimate Below)
2. Institute an accelerated I & I program in the total area impacting the 19th Ward pump station. Evaluate peak flows from contributing pump stations and gravity lines during storm events.
3. Replace two (2) existing dry pit pumps with two new dry pit pumps of about 3,500 GPM each to reduce frequency of overflow events. Use VFD's (Variable Frequency Drive) for speed and capacity control of the new pumps. Revise generator and electrical system as needed for increased pumping capacity. Run parallel and/or replacement force main approximate 18" diameter. Evaluate the 19th Ward pump station force main discharge's influence on the hydraulics of the City's downstream sewer collection and pumping system.
4. Add one large pump and keep existing lead, lag pumps as is. Run parallel and/or replacement force main approximate 18" diameter.
5. Replace one (1) existing dry pit pump with one (1) new dry pit pump of about 3,500 GPM to reduce frequency of overflow events. Use VFD (Variable Frequency Drive) for speed and capacity control of the new pump. Revise generator and electrical system as needed for increased pumping capacity. Run parallel and/or replacement force main approximate 18" diameter. Evaluate the 19th Ward pump station force main discharge's influence on the hydraulics of the City's downstream sewer collection and pumping system. Discuss single motor driven pump replacement with PA-DEP for concept approval.
6. Look at engine driven self priming diesel engine driven pump to carry flows above the capacity of the existing three (3) pumps. Run parallel and/or replacement force main approximate 18" diameter.
7. Replace 1950's vintage pump station and force main to meet 5 MGD peak design capacity based on Chapter 94 reports and Planning modules. Include item No. 1 with this option.

I hope this information is useful. Please call if you have any questions or need more help.

Very Truly Yours,

A handwritten signature in black ink, appearing to read 'Douglas L. McGill', written over a horizontal line.

Douglass L. McGill, P.E.



Appendix 1

19th Ward Pump Station Potential Overflows August 2004 through September 2006

Date	Start Time	End Time	Duration (minutes)	Comments
08/03/2004	07:45	08:05	20	3 pumps running
09/18/2004	10:00	10:15	15	3 pumps running
09/18/2004	16:00	17:00	60	3 pumps running
03/28/2005	15:50	15:10	10	3 pumps running
07/13/2005	19:10	20:20	70	3 pumps running
07/17/2005	15:50	17:25	95	3 pumps running
10/08/2005	12:30	19:30	420	3 pumps running
06/01/2006	21:40	22:20	40	3 pumps running
06/02/2006	21:00	23:00	120	3 pumps most of time
06/27/2006	17:50	18:20	30	3 pumps 15 min/2 pumps 15 min
09/28/2006	16:00	18:00	120	3 pumps running
			1139040 = 99.91%	1 pump running (791 days)
Summary			1000 = 0.09%	11 <i>Potential</i> Events
Average			90	1 hour 30 minutes
Longest			420	7 hours
Shortest			10	10 minutes

Appendix 2

Scope Cost Opinions for Corrective Measures

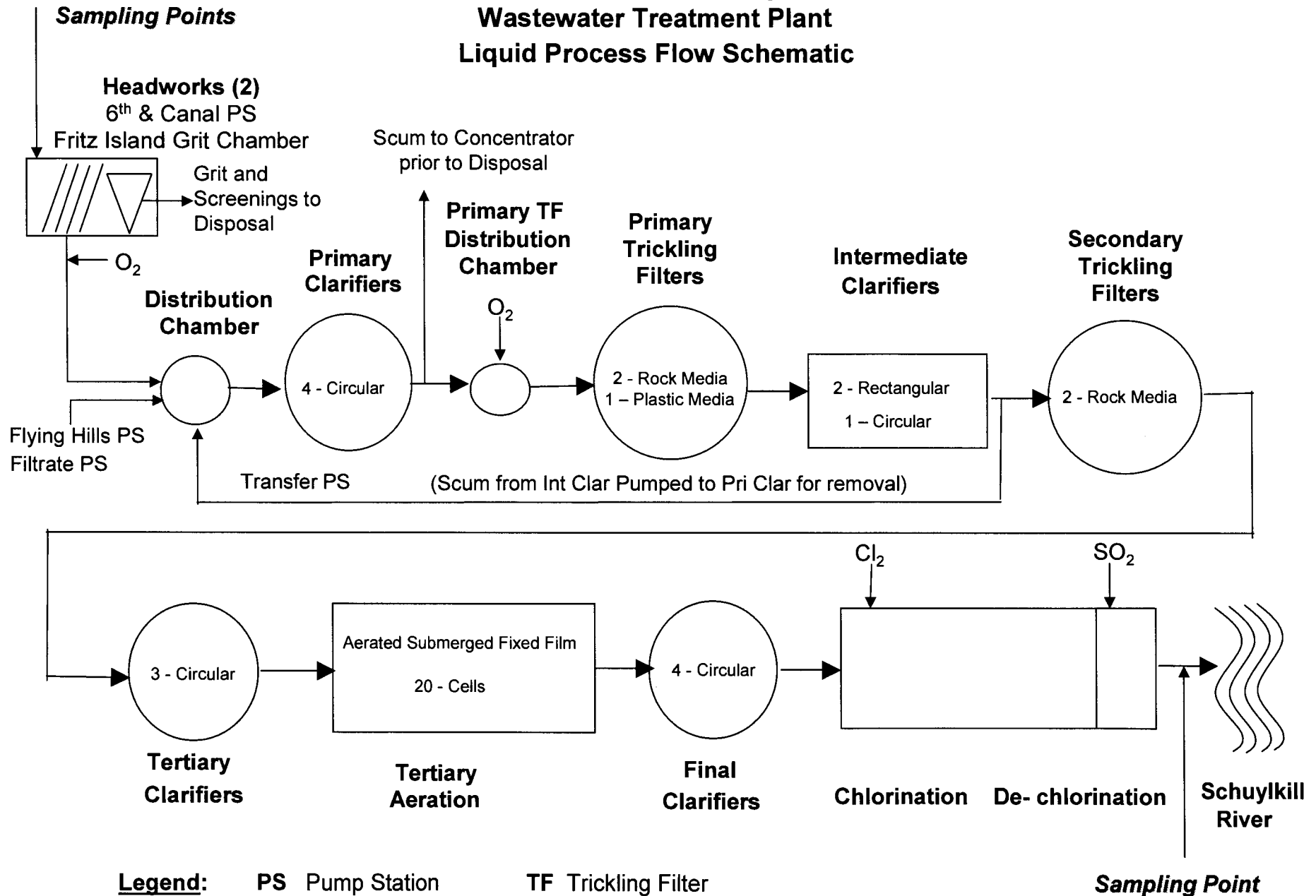
1. a. Install real-time level detection system in the wet well and appropriate manholes with transmission to management. Calculate overflow quantities by mutually agreed upon procedures.
Scope cost Estimate: \$15,000.00 to \$20,000.00
1. b. Install real-time level detection system and overflow metering system at pump station.
Scope cost Estimate: \$100,000.00 to \$120,000.00
2. Institute Infiltration and Inflow Correction Program
Scope cost Estimate: To Be Determined
3. Install two (2) new dry pit submersible pumps with VFD controls of approximately 3,500 GPM each to reduce frequency of overflows. Eliminate one (1) existing pump. Revise generator and electrical system as needed for increased pumping capacity. Run parallel and/or replacement force main approximate 18" diameter.
Pumps installation and demolition: \$600,000.00
Generator and electrical system enlargement: \$350,000.00
18" parallel force main: \$450,000.00
Scope cost Estimate: \$1,400,000.00
4. Install one (1) new dry pit submersible pump with VFD control of approximately 3,500 GPM to reduce frequency of overflows. Eliminate one (1) existing pump. Revise generator and electrical system as needed for increased pumping capacity. Run parallel and/or replacement force main approximate 18" diameter.
Pumps installation and demolition: \$350,000.00
Generator and electrical system enlargement: \$200,000.00
18" parallel force main: \$450,000.00
Scope cost Estimate: \$1,000,000.00
5. Install one (1) 3500 GPM self priming diesel engine driven pump.
Pump installed: \$180,000.00
Electrical system interlocks: \$45,000.00
18" parallel force main: \$450,000.00
Scope Cost Estimate: \$675,000.00
6. New Pump Station:

Scope cost Estimate: \$2,500,000.00 to \$3,000,000.00

Appendix D

Wastewater Treatment Plant Liquid Process Flow Schematic

City of Reading Wastewater Treatment Plant Liquid Process Flow Schematic



Appendix E

Wastewater Treatment Plant
Engineering Evaluation Report covering the
Intermediate Pump Station (IPS), and the
Tertiary Pump Station (TPS)

Douglas L. McGill, P.E.

Consulting Engineer
2807 Fisherville Road
Coatesville, Pa. 19320
610-380-1412

City of Reading

April 2006

ATTN: Ralph E. Johnson, Plant Superintendent

Dear Mr. Johnson,

This letter report summarizes my findings and opinions regarding the capacities of the Flygt pumps at the "intermediate" pumping station and the Flygt pumps at the "tertiary" pumping station based on your request. I am aware that your intermediate clarifiers overflow in a cross country fashion during high flow periods. This occurs at intermediate tank #2 which has a slightly lower top of concrete elevation than intermediate clarifiers #1 and #2. Apparently there has not been a witnessed overflow of the tertiary pump station. However; in this station there is a 42 inch overflow that would divert any flow in excess of the station's capacity, unseen, to your final clarifiers during high flow periods. To conduct the pump evaluation I used existing plant drains to observe the pumps and I accounted for known conflicts in baseline elevations in the plant.

I also used the following information:

1. Flygt pump curves dated 94-06-30 for seven CP3300.181 pumps.

(Five used for forward flow – normally) – Curves were certified by test according to Flygt.

2. Flygt pump curves dated 2003-11-13 for the four 3356/665 tertiary pumps. –

These pump curves were also certified by test according to Flygt.

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Coatesville, Pa. 19320
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3. Field measurements of water elevations to elevate capacity over the range of static lift between high and low set points.
4. Cameron Hydraulic Data 17th Edition for friction calculations.
(using a 15% safety factor)
5. I had a Flygt representative run system and pump curves to confirm my own estimates. These curves are in this report.
6. Field observation of pump operation including inspection for any significant leakage at the metal to metal seat between pumps and “fast outs”.
7. Discussions with John Gerberich regarding maintenance schedule’s including Flygt service; actual measured voltage at the pump, and the method of operation of each station. Since the variable frequency drives are not being used in the intermediate station, the pump motors should be turning at the design speed at all times of operation. The tertiary pumps are being operated variable speed by wet well level transducer measurement and variable frequency drives.

I did not open any of the pump casings to check actual impeller diameters nor did I check actual impeller rotation direction or measure any wear of the impellers. Based on discussions with staff and the apparent continuing high level of Flygt involvement in maintenance, I assume all of the pumps are spinning correctly, however as you know motor rotation can easily be reversed electrically, I personally have found pumps to be

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limping in reverse elsewhere since the initial installation because correct rotation is not always obvious to installers and inspectors. A heavy submersible pump's spin direction cannot always be easily observed before or after setting because of the pump weight, valving, piping configurations and short valve vault distances. Applying exterior "Wrap around" flow metering devices would not be worth the expense to check flows accurately in my opinion because your accessible piping configurations are too complex. I also made the questionable assumption that the butterfly valve located in the 42 inch line from the tertiary pump station to the tertiary clarifiers is fully open and free of debris. This valve has a function at the Reading plant but be sure there are no valves in the main hydraulic passage in the future as its condition will always be questionable.

Along with the Flygt representative we created system curves with parallel pump operation pump curve overlays for both stations system curves. As you know with centrifugal pumps you continually lose capacity in each pump as more and more pumps are operated in parallel. You cannot add the rated capacities of a single pump capacity. Because of the large 36" discharge headers in both stations the pipe friction is low resulting in relatively flat system curves which can minimize the problem of capacity reduction. In the case of your five intermediate pumps parallel pump operation the reduction in capacity is about 1400 gpm per pump compared to a single pump operation

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when the wet well is full and five pumps are running. In parallel a sixth pump would reduce the capacity further.

In the case of the tertiary station the reduction in pump capacity is only about 400 gpm for a single pump when the wet well is full.

From John Gerberich I understand that field measured voltages at the pump exceed the given rated 460 volts; therefore low voltage slow down of the pumps should not be a factor. One of the intermediate pumps had a leak at the seal during the inspection but it was not significant.

The wet well designs are not as good as a theoretical "Hydraulic Institute" design but I don't think there is any significant interference between pumps that might seriously affect their capacity. I've asked Flygt Pumps for an opinion on this.

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SUMMARY

Summary of Investigation of Intermediate Pump Station

1. Five intermediate pumps in parallel cannot keep up with peak influent plant flows. At high wet well five pumps in parallel put out between 28,000 gpm and 30,000 gpm.
2. The four tertiary pumps operating in parallel cannot keep up with the peak plant flows. At a high wet well level the four tertiary pumps have a theoretical output between 29,000 gpm and 30,000 gpm. The valve in this line is a source of potential flow problems.
3. Individual pump capacities appear to be as designed and as delivered.
4. Some minimal gains in pump capacities can be gained with some changes but come with risks to equipment.
5. Adding or changing submersible pumps to the wet wells can get capacities up significantly. The 36" headers have good capacity.
6. Adding parallel pumps outside of the wet wells with separate discharge pipes, can get capacities up significantly, (IE: Godwin type or Gorman Rupp self priming pumps).

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7. Adding pumps to the intermediate station and adding a new final clarifier might have merit rather than more tertiary considering hydraulics and clarifier treatment. Adding significant pump capacity to the tertiary station would probably create washouts at the tertiary clarifiers and could create process problems.

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CONCLUSION

My conclusion based on the available information is that the five pumps in the intermediate station are performing to their rated capacity. The four tertiary pumps, likewise are also performing as Rated.

Since both of these stations are in a series "repump" of the influent flow they must have equal or greater capacity than your influent peak flow which they now do not so you will continue to have periods of overflows without more pump capacity. I expect the overflows may get more frequent with time unless you can reduce the influent flow.

When you use a recirculation pump at the intermediate station as pump #6 for forward flow you do increase the flow here to about 33,000 gpm to 34,000 gpm. Then you cannot handle the flow at the tertiary pumps and this station will overflow. An overflow strategy such as added final clarifier capacity might be a better solution at the tertiary.

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RECOMMENDATIONS AND IDEAS

CATEGORY 1: - Minor Capacity Gains

1. Work with Flygt to see if the existing pumps can be fitted with new impellers to gain 2% – 5% increase in pump capacity. It appears that may be possible with four of the intermediate pumps and the tertiary pumps.
2. When all pumps are on variable speed drive increase operating frequency above 60Hz. to gain 1% - 2% capacity. Flygt indicated that the pumps could be run at 63Hz full time. You could push a little harder on speed to gain a little more capacity but remember you could be stressing the motors. A control program would be needed to limit speed.
3. Keep the wet well levels operating range as high as possible to minimize static head and possibly gain 1 MGD – 2 MGD overall capacity. You should have the plant hydraulics checked. I don't think the gain would all that much but it would be a capacity gain.

CATEGORY 2: - Significant Capacity Gains

1. Install a larger submersible pump in the spare slot at the tertiary pump station if a clarifier is not practical and add one new spot in the intermediate pump station. Large is defined as a pump that will significantly reduce the frequency of backups and overflows (IE: Satisfy PADEP). Piping will eventually become an issue and somehow the overall hydraulic profile of

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pipings and process units should be studied. The effect of increased flow on the existing tertiary clarifiers' performance is questionable so a larger pump in the tertiary station needs more thought.

2. Install two Godwin type self priming pumps or Gorman Rupp self priming pumps at the wet well with separate pipes or hoses for suction and discharge from the intermediate wet well to the tertiary clarifiers head box. Do the same from the tertiary pump wet well to the tertiary clarifiers if the clarifiers can handle the flow. These pumps can be fitted with engine drives, electric drives and use hose or pipe, maybe semi permanent set up or a reasonable emergency set up. The system hydraulics still needs to be addressed.

Other than process problems related to peak flow hydraulics, this pump set up could solve any peak flow repump problem at these pump stations.

Possibly some equipment rental arrangements might be possible if you didn't want a permanent installation. I understand you have a big Godwin pump and so does the collection system division. Personally I would recommend new pumps and auxiliary equipment rather than commit your maintenance equipment to address this capacity.

Douglas L. McGill, P.E.

Consulting Engineer
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CATEGORY 3: - For peak flow conditions, Food For Thought

1. Godwin's for intermediate as above.
2. A new pump and final clarifier to deal with overflows from the tertiary pump station. This could improve your treatment as will provide needed hydraulic capacity. Possibly the clarifier could be planned to fit into the long term plant improvement program.

I hope this information is useful. Please call if you have any questions or need more help.

Very Truly Yours,

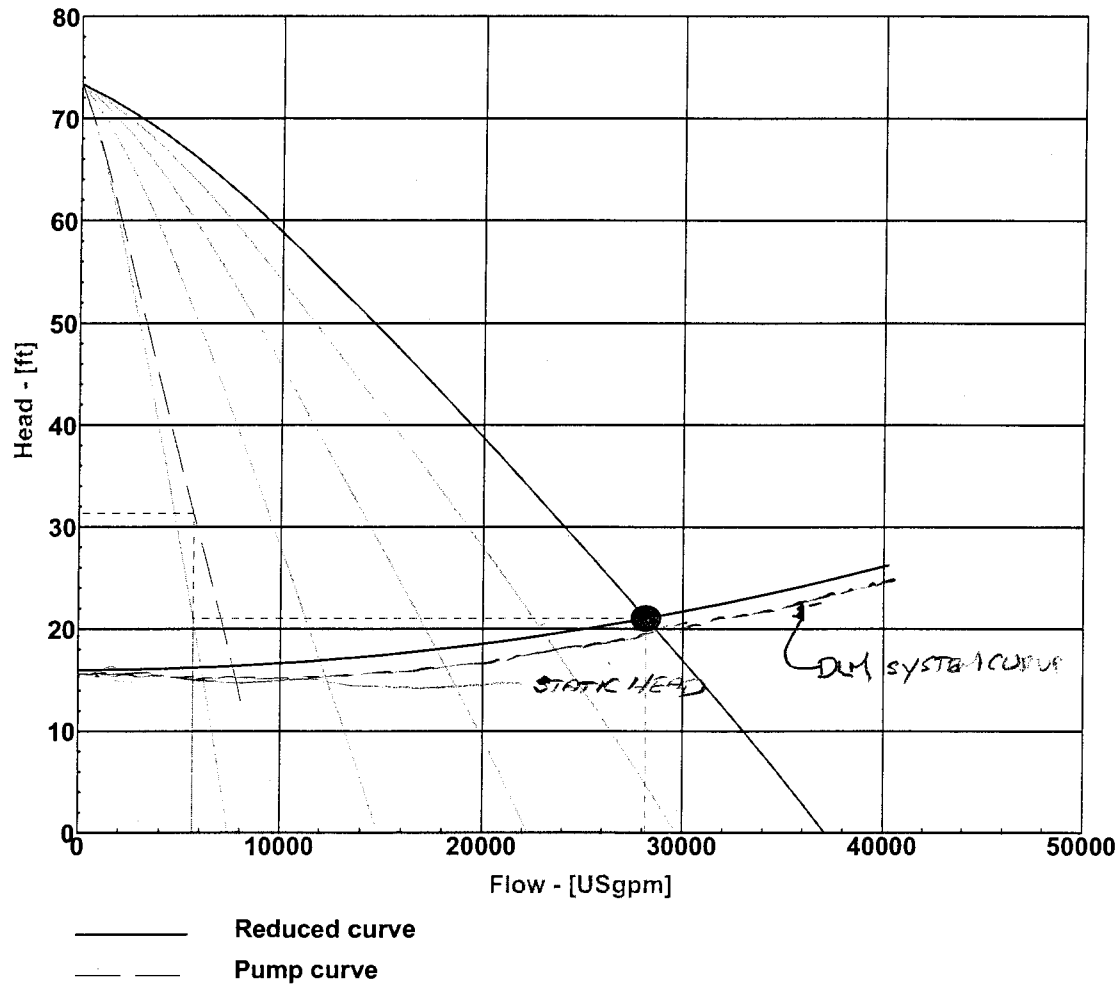

Douglas L. McGill, P.E.



Duty Analysis - Duty conditions

Project: Reading WWTP Intermediate PS

Created by: Arthur W. Auchenbach III



5 CP 3300 63-804-00-8010

PRODUCT DATA

Rtd. pwr.: 60 hp

Imp. diam.: 435 mm

Vanes: 3

Throughlet: 4 inch

DUTY CONDITIONS

No of pumps: 5

Flow: 28160.5 USgpm

Head: 31.3 ft

Reduced head: 21.0 ft

Shaft power: 289.6 hp

Pump efficiency: 77.0 %

Specific energy: 147.6 kWh/mg

Flygt



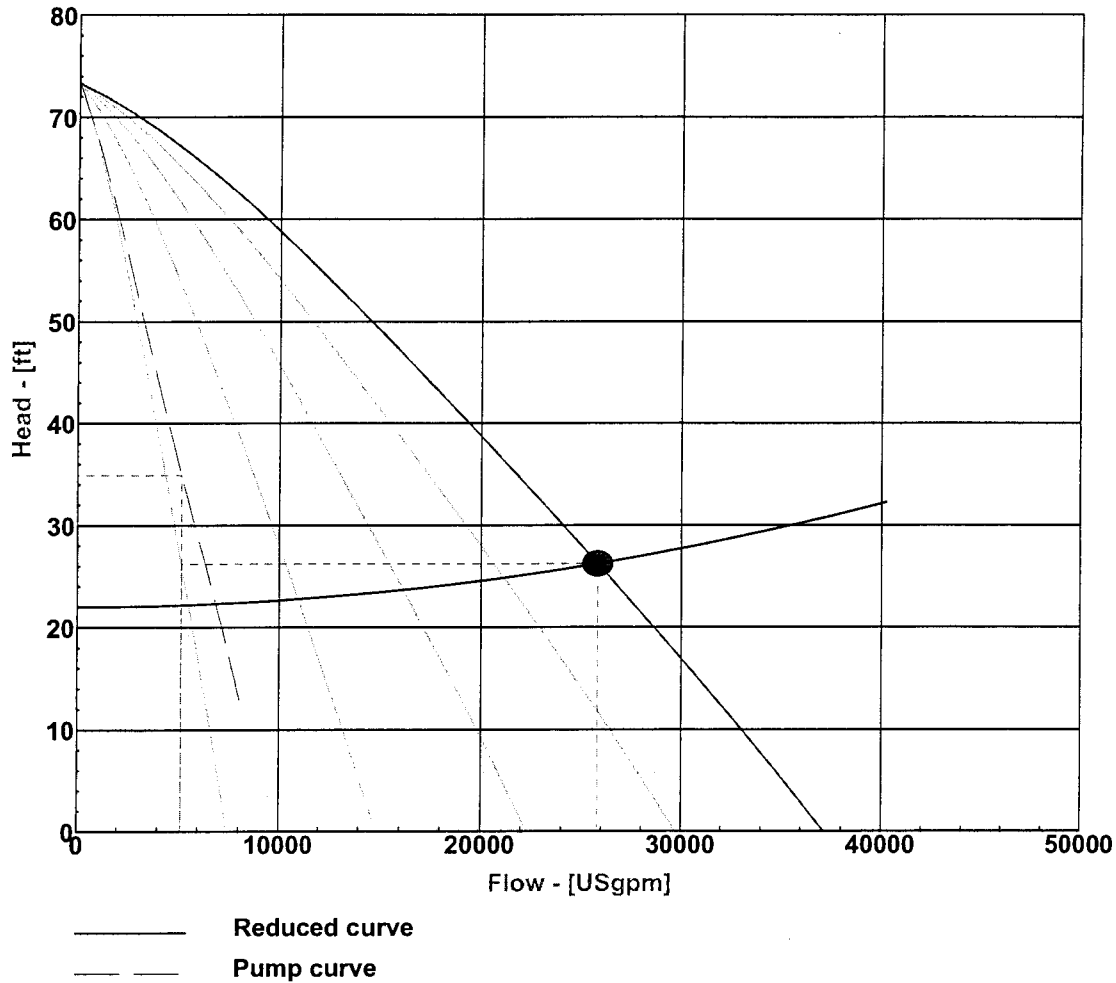
ITT Industries



Duty Analysis - Duty conditions

Project: Reading WWTP Intermediate PS

Created by:: Arthur W. Auchenbach III



5 CP 3300 63-804-00-8010

PRODUCT DATA

Rtd. pwr.: 60 hp

Imp. diam.: 435 mm

Vanes: 3

Throughlet: 4 inch

DUTY CONDITIONS

No of pumps: 5

Flow: 25795.4 USgpm

Head: 34.9 ft

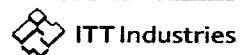
Reduced head: 26.2 ft

Shaft power: 290.9 hp

Pump efficiency: 78.2 %

Specific energy: 161.9 kWh/mg

Flygt

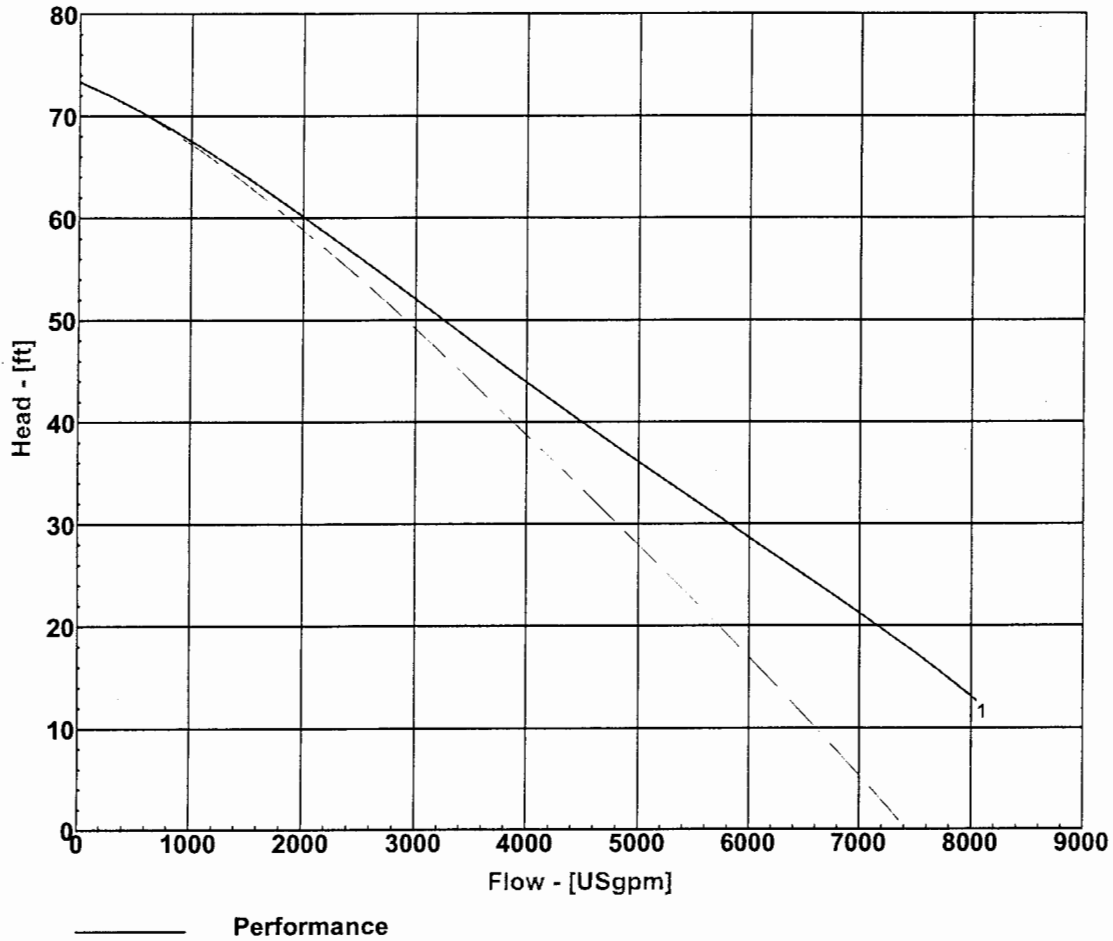




Duty Analysis - Performance curves

Project: Reading WWTP Intermediate PS

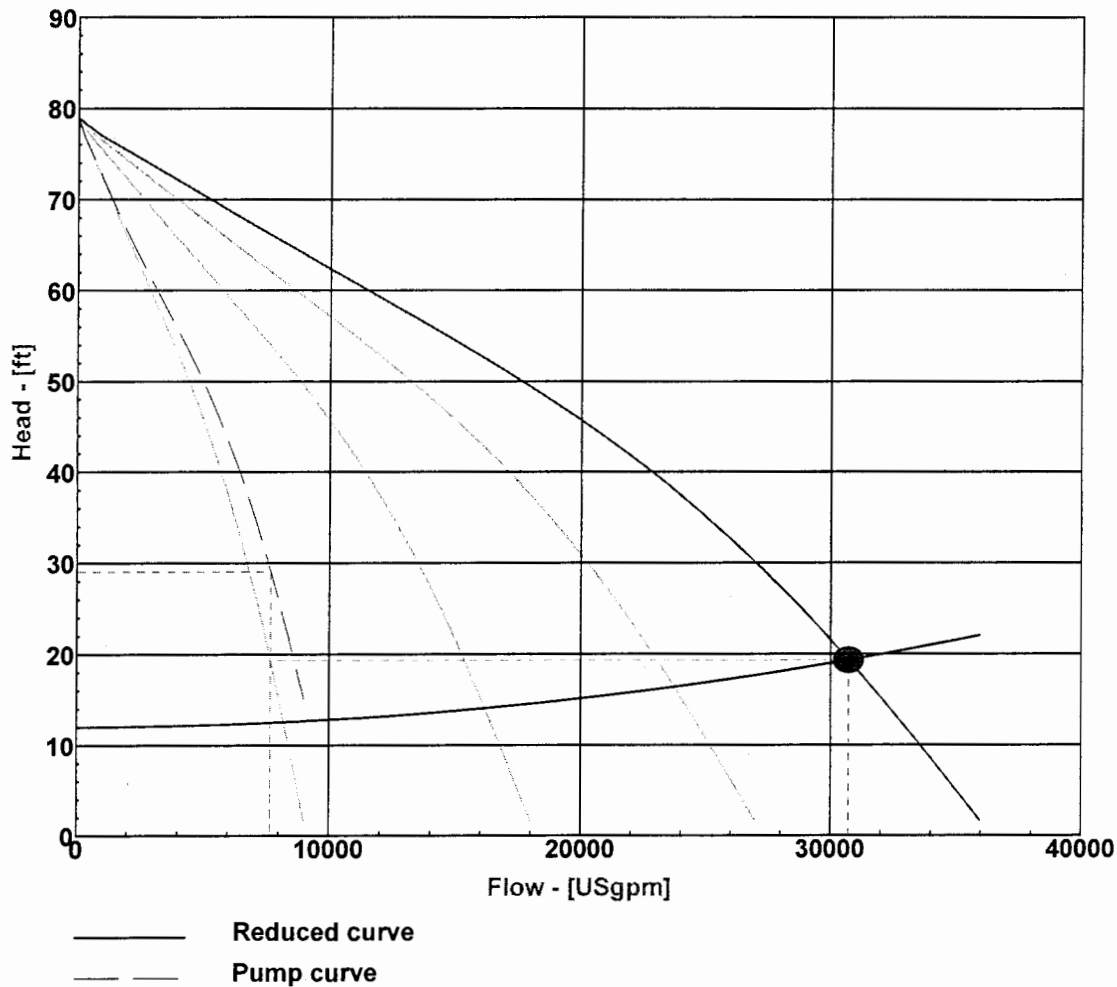
Created by:: Arthur W. Auchenbach III



1. CP 3300 - 63-804-00-8010 60 hp 435 mm

Project: Reading WWTP Tertiary PS

Created by:: Arthur W. Auchenbach III

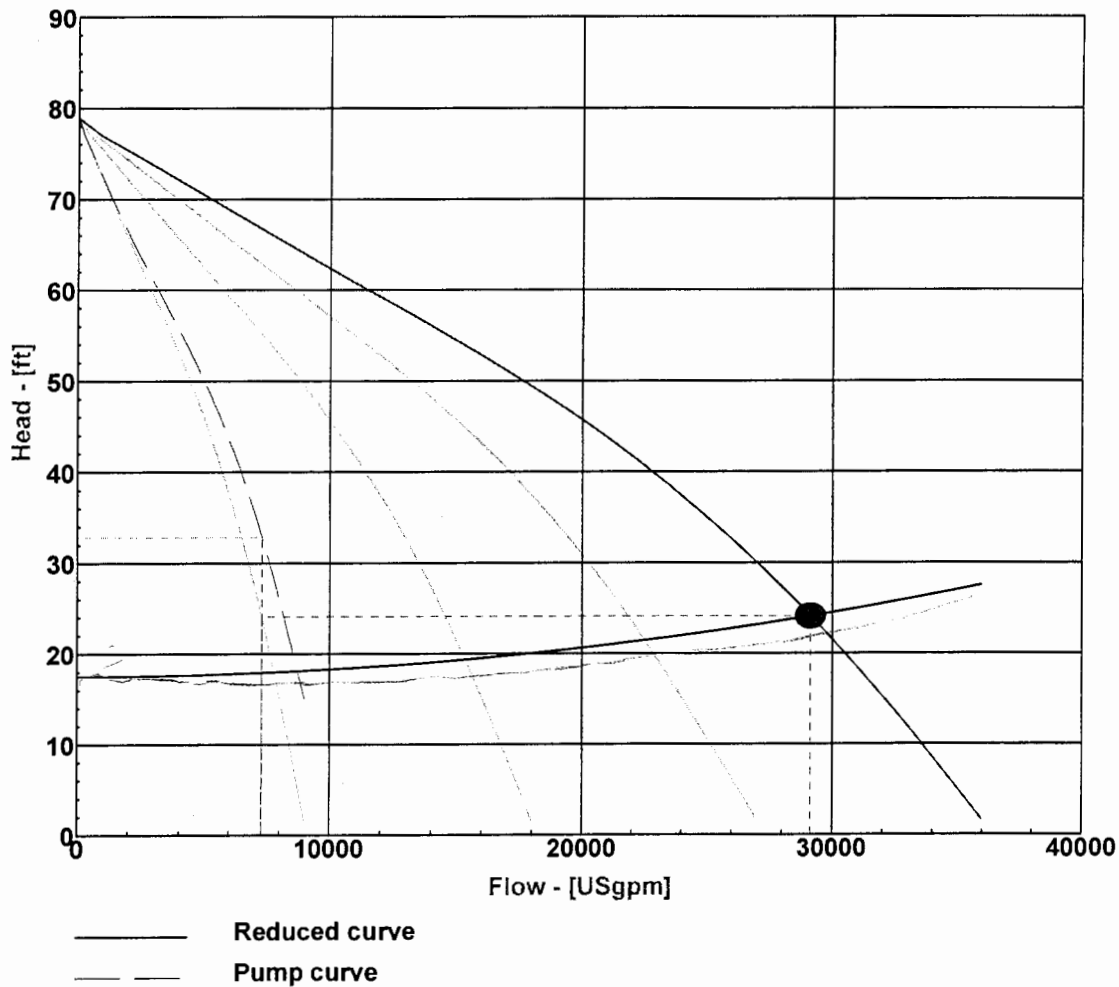


4 CP 3356 63-810
PRODUCT DATA
 Rtd. pwr.: 85 hp
 Imp. diam.: 455 mm
 Vanes: 3
 Throughlet: 4 inch

DUTY CONDITIONS
 No of pumps: 4
 Flow: 30721.2 USgpm
 Head: 29.0 ft
 Reduced head: 19.3 ft
 Shaft power: 306.0 hp
 Pump efficiency: 73.8 %
 Specific energy: 135.6 kWh/mg

Project: Reading WWTP Tertiary PS

Created by:: Arthur W. Auchenbach III



4 CP 3356 63-810

PRODUCT DATA

Rtd. pwr.: 85 hp

Imp. diam.: 455 mm

Vanes: 3

Throughlet: 4 inch

DUTY CONDITIONS

No of pumps: 4

Flow: 29143.1 USgpm

Head: 32.8 ft

Reduced head: 24.1 ft

Shaft power: 311.6 hp

Pump efficiency: 77.7 %

Specific energy: 145.6 kWh/mg



Design pipe system



Project: Reading WWTP Intermediate PS - Case1

3/8/2006

Customer: City of Reading

Arthur W. Auchenbach III

Station Piping 1

			No of		
Length	20.0	ft	Discharge conn.	0.50	1
Material			90° elbow	0.30	3
Pressure class			Valve	1.00	1
Dimension		inch	Tee	0.60	1
C-factor	120.000		Check valve	1.50	1
Inner diam.	14.0	inch	Outlet	1.00	0
			Own	0.00	0
			Total:	4.50	
ft /s			ft		

Force Main 1

			No of		
Length	370.0	ft	Discharge conn.	0.50	0
Material			90° elbow	0.30	2
Pressure class			Valve	1.00	0
Dimension		inch	Tee	0.60	0
C-factor	120.000		Check valve	1.50	0
Inner diam.	36.0	inch	Outlet	1.00	1
			Own	0.00	0
			Total:	1.60	
ft /s			ft		

		No of		
Static Head:	16.0	ft	ft	ft
			ft	ft
			ft	ft
			ft	ft
			ft	ft

Hazen-Williams





Design pipe system



Project: Reading WWTP Tertiary PS - Case1

3/16/2006

Customer:

Arthur W. Auchenbach III

Station Piping 1

			No of		
Length	20.0	ft	Discharge conn.	0.50	1
Material			90° elbow	0.30	1
Pressure class			Valve	1.00	1
Dimension		inch	Tee	0.60	1
C-factor	120.000		Check valve	1.50	1
Inner diam.	16.0	inch	Outlet	1.00	0
			Own	0.00	0
			Total:	3.90	
ft /s			ft		

Force Main 1

			No of		
Length	320.0	ft	Discharge conn.	0.50	0
Material			90° elbow	0.30	3
Pressure class			Valve	1.00	1
Dimension		inch	Tee	0.60	0
C-factor	120.000		Check valve	1.50	0
Inner diam.	36.0	inch	Outlet	1.00	1
			Own	0.00	0
			Total:	2.90	
ft /s			ft		

			No of	
Static Head:	17.5	ft	ft	ft
			ft	ft
			ft	ft
			ft	ft
			ft	ft

Hazen-Williams



Douglas L. McGill, P.E.

Consulting Engineer
2807 Fisherville Road
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ADDENDUM

Pump Station Capacities:

Tertiary pumping station with (4) Flygt pumps running.

Wet well high – 30,500 GPM ± Total
(43.9 MGD)

Capacity per pump – 7625 GPM

Capacity of (1) pump running – 8000 GPM

NOTE: Flat system curve and pump curves result in only a small
capacity change per pump.

Intermediate pumping station with (5) Flygt pumps running.

Wet well high - 28,000 – 29,000 GPM ± Total
(40.3 MGD)

Capacity per pump – 5600 GPM

Capacity of (1) pump running – 7000 GPM

NOTE: Same as above but reduction from rated capacity is
somewhat greater per pump.

Appendix F

Wastewater Treatment Plant
Engineering Evaluation Report covering
Economical Options for a WWTP
Interim Effluent Pumping Station

Douglas L. McGill, P.E.

Consulting Engineer
2807 Fisherville Road
Coatesville, Pa. 19320
610-380-1412

April 24, 2007

City of Reading
815 Washington Street
Reading, PA 19601
Subject: 19th Ward Pumping Station

ATTN: Ralph E. Johnson, Plant Superintendent

Dear Mr. Johnson,

This report supplements the Hyder Consulting (ARRO), Inc., report of April 2000 which dealt with relief of hydraulic restrictions and flooding of low lying areas of the Fritz Island Waste Water Treatment Plant. Hyder's plan was contracted prior the Consent Decree and their proposed design therefore was more permanent in nature than the concepts presented herein. This analysis is limited to the flooding issue only. My alternatives are somewhat less permanent in nature than Hyde's but the equipment proposed is of the same quality.

The most recent flood condition at Fritz Island was in June of 2006. Per your instructions I did not examine internal plant flow restrictions. In this assignment the objective of this work was to examine alternative and more temporary ways of protecting the final clarifier drives, the intermediate clarifier drives and sludge facilities than the more permanent flood pump facilities proposed by Hyder in the 2000 report. You will remember that Hyder also suggested storage replacement drives, valve operators and other equipment which would be used as replacement items after flood waters receded as apposed to flood pumps.

As stated in the PADEP Domestic Wastewater Facility Manual the treatment plant "structure, electrical and mechanical equipment shall be protected from physical damage

by the 100 year flood". Your low lying equipment is protected from the 100 year river flood event by a dike however; during a high river level due to Local River flooding your sewage flow is also peaking. Occasionally up into the 70 MGD range. The flow is obviously due to inflow and infiltration throughout the collection system. The effect is that the plant can flood from with-in and have a partially treated waste flowing to the river over the dike or other low spots in the plant that can be breached.

As shown by the June 2006 flood experience the actual damage to plant equipment was minimal but operational problems due to the condition of old buried conduit and wire continued sporadically for several months while repairs were being made.

The same PADEP manual also states that "a treatment plant should remain fully operational and accessible during the 25 year flood". My calculations indicate that portions of the plant including disinfection are not properly operational during a 25 year river flood event. Again, damage to the facility is readily repairable.

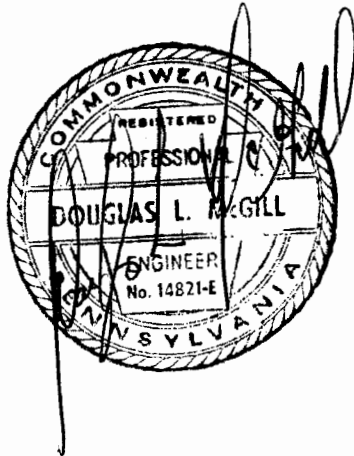
It is my opinion that there should be effluent flood pumps at the current plant to comply with the 25 year river flood event conditions as strictly interpreted. Use of these pumps could also result in compliance during a 100 year river flood event. I am also of the opinion that flood pumps at the Reading Plant would infrequently be needed and they should be as considered "Emergency Protection" items such as an emergency generator is for electrical outages. For this reason and for the short term of the Consent Decree I do not feel duplication of such pumping equipment is warranted. I have not included duplication in cost of my scope cost estimates. Duplication would almost double the scope cost estimates.

I have offered several alternate interim pumping system concepts for your consideration. I personally believe the diesel engine driven multiple self priming pumps offers the most advantages to the City and that it meets the intent of the interim wet

weather operational strategy, however all of the concepts can be made to deal with plant flooding. Please advise if you need more information or have any questions.

Very truly yours,

Doug McGill, PE



BASIS USED FOR REEXAMINATION OF HYDRAULICS:

1. Hyder Consulting – Hydraulic Review RE: Fritz Island – Report of April 2000

Hyder concluded that the frequency of potential flooding of the plant low area correlated to an approximate 6 year storm event with an assumed peak influent flow of 42.75 MGD (Part #1 Hyder Report).

The peak influent sewage flow values are just as problematic to flooding the low treatment plant areas as is the river level.

2. Part #2 of the Hyder report established 67.4 MGD as a potential peak flow. The staff has observed 70 MGD± in recent years. The frequency of potential plant flooding would increase.
3. (USGS) Elevations were used. Not the Reading Datum.

CONCLUSIONS:

- At a peak influent sewage flow of 70 MGD (48,600GPM) together with a 100 year river flood elevation (196.23ft.) the treatment plant will flood internally as the effluent cannot flow by gravity to the river. Physical damage would be minimal and of short term as described below. Effluent pumping could resolve the flood problem up to the protective height of the dike.
- At a peak influent sewage flow of 70 MGD and a 25 year river flood elevation (192.80) the treatment plant would not be completely operational as the following units would be flooded out.

Structure	Top of Tank Wall/Slab
1. Chlorine Contact Channel	El. 191.47
2. Final Settling Tank Effluent Channel	El. 192.05
3. Final Settling Tank #1	El. 192.05
4. Final Settling Tank #2	El. 192.05
5. Final Settling Tank #3	El. 192.05
6. Final Settling Tank #4	El. 193.47
7. Final Settling Tank Diversion Box	El. 192.05
8. Intermediate Settling Tank #1	El. 192.30
9. Intermediate Settling Tank #2	El. 192.05
10. Intermediate Settling Tank #3	El. 192.30
11. I.S.T. #1 & #2 Flow Diversion Box	El. 195.30
12. Final Sludge Pump Station	El. 193.05
13. Multiple Electrical Systems	El. Several (Overhauled after the recent flood)

NOTE: These process units were flooded out from within on June 27th & 28th 2006 with an equivalent 100 year river flood elevation and a peak raw sewage flow greater than 65 MGD. The plant was returned to service with-in 8 hours. Problems (Primarily electrical) resulting from the flooding in the low area of the plant continued to occur into 2007. Electrical corrections were still being finalized in January of 2007.

- Your 3 spare flight submersible pumps would provide about 5,000 GPM each (Est. 15,000 GPM Total) if installed in the chlorine contact channel as emergency flood pumps. This capacity is far short of your average daily flow let alone the peak flows. These pumps supplemented with other pumps delivering about 30,000 GPM could protect the plant against the peak flow at flood conditions however the system would be more complex than it should be in my opinion.
- Based on Hyder's projections and the City's June 2006 actual flood experience return to operating service from flood conditions can be quickly rectified. While not meeting PADEP's requirement to remain fully operational during a 25 year river flood event, there maybe an arguable case for a repair alternative considering the city's performance minimizing a non operational condition to less than one half a day.
There is a good case to argue that the plant is now reasonably protected from physical damage during the Hundred Year Flood; again based on the minimal damage experienced, the City's fast response during the June 27th & 28th 2006 flood, and the newly installed electrical wiring.
- Sewage flood "pumping" as projected by Hyder in the 2000 report and as refined in this report for an interim period could be designed to "Keep the plant operational" and accessible during the 25 year river flood event with a peak influent sewage flow of 70 MGD or greater. Wastewater treatability at these peak flows was not reviewed. It is fairly evident that disinfection performance would be questionable.
- Some other modifications and additions required to eliminate and or further minimize damage during a 100 year river flood event with peak influent flows other than pumping are:
 - Fuel storage and rotation of fuel in the case of engine driven flood pumps.
 - Independent emergency power in the case of motorized flood pumps.
 - Pump speed and/or other operational controls.
 - The existing outfall headbox with sluice gate require maintenance, structural and electrical modifications if the plant is to be protected from flooding conditions.
- Flood pumps would be required to remain fully operational during a 25 year river flood event. By the nature of any practical flood pump arrangement and a properly elevated corrected headbox the plant could also remain operational and protected during a 100 year river flood event with peak inflows.
- The selection of a new flood pumping system versus possible repairing of flooded equipment after a flood is primarily a case to be made by the City of Reading and tempered by PADEP/EPA approvals. The time frame for a future treatment plant and the need for pumping facilities in the existing treatment plant versus probabilities of more severe flooding events is a factor in evaluating the alternative of repairing damaged equipment versus new pumping as is PADEP's input to the problem in my opinion.

POTENTIAL FLOOD PUMPING DESIGN CONCEPTS:

1. The Hyder Design concept of 2000 considered four (4) submersible flood pumps located adjacent to the chlorine contact channels, a new headbox and a new sluice gate. It utilized the existing 48' outfall pipe.

Their proposed facilities have a permanent nature. Hyder's 2000 cost estimate was \$1,131,851.00. Using the October 2006 Engineering News Record Construction Cost Index to the January 2000 index a factor of 1.3 was calculated. Using this factor the 2006 cost estimate would be about \$1,500,000.00 for the same facility. Considering the current rapidly rising costs of construction materials this updated \$1,500,000.00 estimate should be considered very un-conservative in my opinion.

2. I looked at the following other flood pumping possibilities which have a more temporary nature than that previously considered:

- a. A grouping of engine driven self priming construction type centrifugal pumps with upgrades to the existing head-box and fuel storage.
- b. Same as "a" above with a direct purchase or rental of the pumps.
- c. A single submersible variable speed flood pump in the chlorine contact channel or in an adjacent pit with upgrades to the existing headbox, modifications to the chlorine contact channel and a committed engine/generator set to run the pump and associated flood control items only.

(Submersible pumps considered were conventional nonclog centrifugals, axial flow types and propeller types)

- d. A single effluent screw pump was also considered. This is a more permanent type pump than the others but is a conventional application.
- e. A grouping of existing Reading spare pumps and supplemental new pumps.

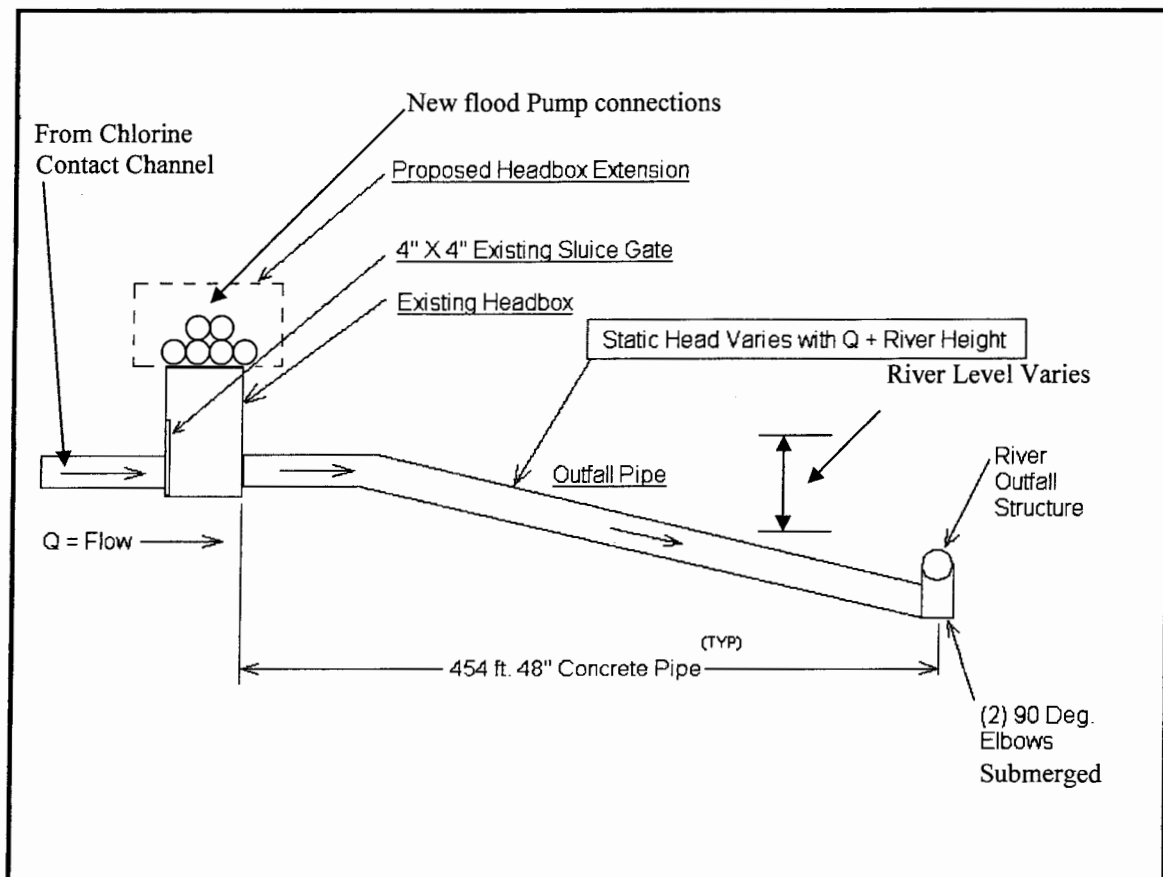
NOTE: All concepts examined have no back-up pumps. Back-up pumps if required would create higher costs. Considering time frames to construct a new plant and the relative infrequent need of the pumps I believe a "single emergency flood pump" concept is very reasonable but PADEP concurrence would probably be required.

HYDRAULIC ESTIMATES:

The following schematic drawing shows the headbox and the 48" outfall pipe submerged in the Schuylkill River. The river elevation varies with upstream the river and weather conditions. The peak plant sewage flow ranges up to 70 MGD at this time. A series of calculations for Q (flow) of 72MGD, 36 MGD and 20.1 MGD show the friction loss (or back-up) in the 48" outfall pipe based on clean pipe conditions. These hydraulic friction losses plus the river elevations determine what the approximate elevation of the water will be in the outfall pipe or in the plant itself.

City of Reading Waste Water Treatment Plant

OUTFALL



Q peak = 46,500 GPM (67.5 MGD)

Losses	entry 1	Sharp Entry (Cameron	$K=0.5$
	exit 1	Hydraulic	$K=1.0$
	entry 3	Data P. 116)	$K=.05$
	exit 3		$K=1.0$
48" 90° els	Eq L each = 90		

48" pipe with Total Equivalent Length = $450+200=650$ ft.
(I used 800 ft. in my calculations.)

EXAMPLE SUMMARY OF OUTFALL

Example #1 shows that with a nominal average river level of 182.5ft. (USGS) and a nominal plant inflow near the current design condition (30 MGD) the water level in the outfall to drive out the 30 MGD will need to be 183.6ft. (USGS). The calculation shows that the water level will back up in the outfall pipe and be non-flooding in the plant. (Most Normal Condition)

Example #1 shows that at the 25 year river level of 192.80 (USGS) together with a very high but less than peak sewage flow observed of 50 MGD the water level at the plant outfall would be 196.36 (USGS). This results in plant flooding in the low lying areas. The plant would be non-operational to the extent discussed elsewhere in this report.

Example #2 shows that at the 25 year river flood elevation of 192.80 (USGS) and a nominal average sewage flow of 50 MGD the water level at the plant would be 193.4 (USGS). In my opinion this elevation is still marginally non-operational. The 20.1 MGD is in the range of average daily flow, not a peak

Example #3 shows that at the 25 year river flood elevation of 196.23 (USGS) and a nominal Sewage flow of 70 MGD to the plant the partially treated sewage will actually flow out over the protective dike into the river rather than have the river flow in over the dike. Again, pumps could solve this problem.

CALCULATIONS:

Q = @ 50,000 GPM - (72 MGD) – Sewage Flow

$$\frac{V^2}{2g} = 1.22 \text{ ft.}$$

$$\text{Headloss}/100 \text{ ft.} = 0.389 \text{ (Safety Factor} = 15\%)$$

$$\begin{aligned} \text{Headloss} &= (0.389)(8)(1.15) + (0.5)(1.22) + (1.0)(1.22) + (0.5)(1.22) + (1.0)(1.22) \\ &= 7.24 \text{ ft.} \end{aligned}$$

Q = @ 35,000 GPM - (50.4 MGD) – Sewage Flow

$$\frac{V^2}{2g} = 0.193 \text{ ft.}$$

$$\text{Headloss} = 0.175 \text{ ft. /100}$$

$$\begin{aligned} \text{Headloss} &= (0.193)(8)(1.15) + (0.5)(.593) + (1.0)(.593) + (0.5)(.593) + (1.0)(.593) \\ &= 3.56 \text{ ft.} \end{aligned}$$

Q = @ 25,000 GPM - (36 MGD) – Sewage Flow

$$\frac{V^2}{2g} = 0.304 \text{ ft.}$$

$$\text{Headloss} = 0.100 \text{ ft. /100}$$

$$\begin{aligned} \text{Headloss} &= (0.100)(8)(1.15) + (0.5)(.304) + (1.0)(.304) + (0.5)(.304) + (1.0)(.304) \\ &= 1.8 \text{ ft.} \end{aligned}$$

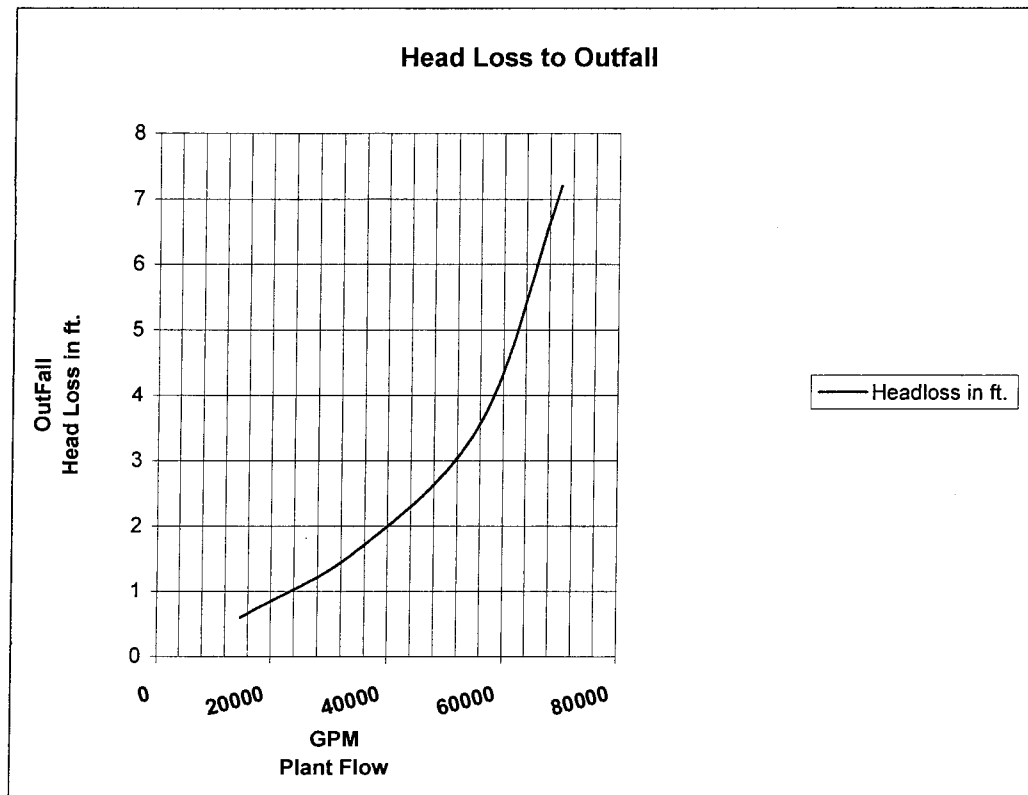
Q = @ 14,000 GPM - (20.1 MGD) – Sewage Flow

$$\frac{V^2}{2g} = 0.096 \text{ ft.}$$

$$\text{Headloss} = 0.033 \text{ ft. /100}$$

$$\begin{aligned} \text{Headloss} &= (0.033)(8)(1.15) + (0.5)(.096) + (1.0)(.096) + (0.5)(.096) + (1.0)(.096) \\ &= 0.59 \text{ ft.} \end{aligned}$$

HEAD LOSS FOR THE 48" OUTFALL



Flow to Outfall

RIVER STAGES / (HYDER STUDY OF 2000)

1. Average Level = 182.5 ft.
2. 25 yr. Storm Level = 192.80 ft.
3. 100 yr. Storm Level = 196.23 ft.

Example #1 – Determined Water Level in Plant or outfall pipe

Average River Level @ 30 MGD Reading Sewage Flow (*Influent*)
Level = $182.50 + 1.60 \text{ ft.} = 183.60 \text{ ft.}$

NOTE: 48" pipe flowing partial/full duration to 183.60 ft.
(*All Structures and Processes are OK. Since levels in low areas are above 183.60ft. (USGS), back-up is inside the outfall pipe below the plant*)

Example #2 – 25 yr. Flood Elevation in river (192.80 (USGS))

Effluent flow through the Plant = 50 MGD
Plant Level = $192.80 + 3.56 \text{ ft.} = 196.36 \text{ ft.}$

NOTE: Water is above Chlorine Contact Channel elevation of 191.47 ft. and is flooding significantly into low lying areas of the plant. Dike is OK at elevation of 198.00 ft.
(Plant is not operational)

Example #3 – With the river water level at 25 year river flood elevation of 192.80 (USGS). This is 1 ft. below top of Chlorine Contact Channel.

Water level in Chlorine Contact Channel = $192.00 \text{ ft.} - 1.00 \text{ ft.} = 191.00 \text{ ft.}$
(USGS)
= Level entrance Pipe

$Q = 35 \text{ MGD} \pm$

Example #4 – (Worst Case Expected to Date)

At 100yr river level and 70 MGD sewage flow to plant

Theoretical Water Level = $196.23 \text{ ft.} + 7.00 \text{ ft.} \pm = \underline{203.00 \text{ ft.}}$

NOTE: Dike is topped from within at an elevation 198.00 ft.
Sewage flows to the river over the dike unless pumps are available.

When positioning equipment other than submersible motors/pumps, set at a minimum of 203.00 ft. (USGS) to protect emergency equipment if system pumps do not function. These pumps should be set at Dike level to stay above worst case river level and worst case plant influent level. Additional suction of approx 5 ft. is needed if pumps are set at 203.00 ft.

SCOPE COST ESTIMATES OF FLOOD PUMPING CONCEPTS

The following are the Scope Cost Estimates developed from equipment cost information and non-engineered cost estimates of concepts. I have entered my opinion of the time it would take to complete the design, obtain permits, bid the project and construct the project for each alternative. I have also included a page for the updated Hyder Concept estimate of April 2000 and a page for a no pump alternative that in my opinion has merit but does not comply with the PADEP Domestic Wastewater Facility Manual or the wording in the Consent Decree.

Engine Driven Self Priming Godwin Pumps System Components Scope Cost Estimate

6 – Self Priming Engine Driven Pumps to provide for peak flow
 9000 GPM pumping capacity of each pump for a total of 48,600 GPM.
 48,600 GPM = 70 MGD
 25' TDH & approx 20ft. suction lift
 Each pump complete with speed controls and 500 gal. Cubical diesel fuel tank.

Pump Cost: (Direct to the City)	\$150,000.00 (EA) = \$900,000.00
Pump Control Package (Level)	\$15,000.00
Leveling Crushed Stone or Concrete Pad by Chlorine Contact Channel	\$26,000.00
Jersey Barriers / Precast concrete structure with grating, Access ladders and safety rails to elevate the pumps.	\$27,000.00
Raise existing outfall box and increase length & width to accept pipe connections from pumps.	\$35,000.00
Repair and modify existing Sluice Gate. Add motor drive with automatic / manual controls.	\$32,000.00
Modify Chlorine Contact Channel divider wall & add Anti-short circuit baffling.	\$25,000.00
Suction pipe and discharge piping for each pump with pipe supports connected to the outfall box downstream of Sluice Gate.	\$65,000.00
Conduit and wire from existing plant source (elevated run on Existing hoist structure). 110 volt for battery charger, platform Lighting and convenience outlet.	\$15,000.00
System monitoring panel in existing building above Flood elevation.	\$10,000.00

Sub Total: \$1,150,000.00

Contingency: \$170,000.00

Total Scope Cost Estimate: \$1,320,000.00

Estimate of recovery cost through sale of low usage engine driven pumps: - (\$480,000.00)

Possible Scope Cost: \$840,000.00

Estimated Time for Engineering, Permitting and Construction (15 Months)

Single 48,600 GPM Submersible Pump System Components Scope Cost Estimate

Submersible pump of 48,600 GPM @ 25 ft. TDH capacity With 460 volt motor inverter duty ready.	\$350,000.00
Rails, hoist and concrete pad.	\$6,000.00
Level / Flow control panel.	\$15,000.00
NEMA 4 VFD panel with harmonic filter.	\$50,000.00
Structure to elevate panel complete with ladder, deck, rails And lighting.	\$85,000.00
Committed diesel generator set with belly tank, silenced with outdoor installation.	\$390,000.00
Gen Set pad.	\$5,000.00
Raise existing outfall box and increase length & width to accept discharge pipe connection from pumps.	\$32,000.00
Elevated 480 volt power and 110 volt control wiring with conduit from Gen Set to VFD panel & submersible cable to pump.	\$28,000.00
Discharge pipe with pipe supports to modified outfall box.	\$50,000.00
System monitoring panel in existing building above Flood elevation.	\$15,000.00
Repair and modify existing Sluice Gate. Add motor drive with and automatic / manual controls.	\$12,000.00
Modify Chlorine Contact channel divider wall. Install special pump chamber.	\$50,000.00

Sub Total: \$1,088,000.00

Contingency: \$168,000.00

Total Scope Cost Estimate: \$1,256,000.00

Estimated Time for Engineering, Permitting and Construction (18 Months)

Three Existing 4,000 GPM Flight Submersible Pumps
With one supplemental submersible pump
System Components
Scope Cost Estimate

Existing Pumps Relocated:	\$60,000.00
Supplemental 36,600 GPM Submersible pump @.25 ft. TDH. With 460 volt motor inverter duty ready:	\$180,000.00
Guide rails, hoists, put down pad for pumps:	\$60,000.00
Discharge piping for each pump with pipe supports connected to outfall box downstream of the Sluice Gate.	\$55,000.00
Committed Diesel Generator Set with fuel tank, silenced for Outdoor installation.	\$450,000.00
Concrete pad for generator set.	\$5,000.00
Conduit and wire from elevated generator set for power, control, Lighting, convenience at the pump area (Multiple pumps).	\$48,000.00
NEMA 4 control panels with VFD's and harmonic filters for controlling multiple pumps.	\$70,000.00
System monitoring panel and in existing building above Flood elevation. Level / Flow control panel / system.	\$15,000.00
Structure to elevate control panel.	\$85,000.00
Repair and modify existing Sluice Gate. Add motor drive with automatic / manual controls.	\$32,000.00
Modify Chlorine Contact channel divider wall and add Anti short circuit baffling.	\$25,000.00
<hr/>	
Sub Total:	<u>\$1,085,000.00</u>
Contingency:	\$160,000.00

Total Scope Cost Estimate: \$1,245,000.00

Estimated Time for Engineering, Permitting and Construction (20 Months)

48,600 GPM Single Screw Pump and System Components Scope Cost Estimate

1 – 60in. diameter 350/400 hp, 480 volt, 3 phase, 60 hz motor and screw pump in a concrete structure with an 18ft. lift to provide for a peak flow of 70 MGD.	\$335,000.00
Pump control package.	\$15,000.00
Concrete pump containment structure and wetwell.	\$300,000.00
Access stairs, platforms and safety rails to access the pump drives.	\$50,000.00
Modify and raise the existing outfall box to accept screw pump discharge.	\$65,000.00
Repair and modify the existing Sluice Gate. Add motor drive with automatic/manual controls.	\$32,000.00
Modify existing chlorine contact channel divider wall And add Anti short circuit baffling.	\$25,000.00
Committed Diesel Generator Set with fuel tank, silenced for Outdoor installation.	\$350,000.00
Concrete pad for generator set.	\$5,000.00
Conduit and wire from elevated generator set for power, control, Lighting, convenience at the pump area.	\$28,000.00
System monitoring panel in existing building above Flood elevation.	\$10,000.00

Sub Total:	<u>\$1,215,000.00</u>
Contingency:	\$185,000.00

Total Scope Cost Estimate: \$1,400,000.00

Estimated Time for Engineering, Permitting and Construction (24 Months)

No Pump
Modify equipment and access in flood zone
Stock vulnerable parts
System Components
Scope Cost Estimate

Storing parts to replace after submergence damage.	\$200,000.00 - \$600,000.00
----------------------------------------------------	-----------------------------

NOTE: While not in compliance with remaining operational during a 25 year flood this could be an acceptable alternative to PADEP / USEPA considering time frame for flood pumps, new plant etc. The electrical problems that caused operational problems during the June of 2006 flood have been corrected. Disinfection would still be questionable during a 25 year flood.

Estimated time the restore the operation after a 25 year flood would be from 1 day to 1 week.

Appendix G

Key SOPs Already Implemented

1. Sanitary Sewer Collection System Inspection SOP
2. Storm Sewer Collection System Inspection SOP
3. Post-Event Sanitary and Storm Sewer Collection System Inspection SOP
4. Storm Flow SOP for the Wastewater Treatment Plant



CITY OF READING, PENNSYLVANIA

Sewer System SOP

SUBJECT: Sanitary Sewer Collection System Inspection

DRAFT

PROCESS DESCRIPTION

Inspection of all sanitary sewer located in critical high flow zones. The inspection of manhole locations for any conditions that may cause a higher than normal flow level is required to ensure that any sanitary sewer overflows (SSOs) will be minimized. Inspections will be conducted based on predetermined zones that have been located by flow monitoring methods. Inspections will also be conducted with respect to the Safety Description and Methods & Actions section of this SOP.

SAFETY DESCRIPTION

All safe working standards will be followed at all times, with consideration to safe equipment operation and proper lifting practices. Head, Foot, Hand, Ear and Eye protection will be used. A manhole cover removed with a manhole pick or hook when a truck mounted lifting crane is not available. A catch basin grate must be removed with a truck mounted lifting crane. Manhole inspections will be conducted using "OSHA Code of Federal Regulations, CFR Title 29 part 1910.146 Standards" (Permit – required Confined Space) Atmospheric monitoring equipment will be used with respect to the Federal Regulations and the departments confined space check list will be utilized. The crewmembers will monitor for concentration levels of hydrogen sulfide, carbon monoxide, explosive conditions and oxygen levels to ensure a safe working environment. No crewmember will enter a manhole that has been declared unsafe for human exposure without the proper safety equipment for the environment. Self contained breathing apparatus (SCBA) will be used if entry to a manhole must be performed. Crewmembers will work in pairs (2 crew members) at all times.

NOTIFICATION PROCESS

The Systems Superintendent and Foreman will be contacted when,

- A trigger event has occurred as identified below,

The Wastewater Superintendent and the WWTP on duty Shift Supervisor must be contacted whenever:

- A treatment unit function may become outside the parameters set by the WWTP SOP's and/or the established WWTP Process Control Plan.

The procedure for contacting a Shift Supervisor is to contact them by radio, cell phone, or in person.

AUTHORIZED ACTIVITIES

The responsible crew member will inspect all designated critical sanitary high flow zones to ensure that the sanitary sewer system is free flowing and with no impediment to the normal flows that have been established.

AUTHORIZED PERSONNEL

All sanitary and storm sewer crew members are covered by this established SOP.

METHODS & ACTIONS

Work orders will be generated routinely for crewmembers to inspect and clean the sanitary sewers high flow zones. This will ensure the sanitary sewer system will maintain proper flows at all times, minimizing potential SSOs.

All safety practices outlined in this SOP will be followed to avoid any possible injuries to crew members.

Proper traffic control methods will be used at all times. The traffic control methods used will be in compliance with City standard practices and Pennsylvania Department of Transportation standards. Methods will include, traffic lane closings, flaggers, lane closed or road closed signs placed at the proper location, traffic directional arrow boards, barricades and traffic cones as required.

If entry to a manhole must be performed the following equipment must be used: safety harness with life line, tripod and winch for entry and removal of a crewmember or crewmembers, self contained breathing apparatus (SCBA) gear will be on site and used if the environment is considered hazards, ventilation blowers will be used at all manhole locations that must be entered.

Manhole inspections will be conducted and the following information will be recorded.

- Removal of the manhole cover and inspection to the condition of the cover will be conducted
- The condition of the manhole rim, flanges, walls and bottom will be recorded.
- Inspection will record and build up of grease, roots and anything that would impede the proper flow of the system at the location. Cleaning of the manhole location will follow as needed.
- The flow through the manhole location will be established by the method of this SOP. System flow measurement will be made using the basic calculation: diameter of the line feeding the manhole divided by the depth of the flow. This factor will be logged on the inspection log form. When this is less than 2 (the flow is more than half-pipe in depth), the line will be scheduled for cleaning to ensure that the system will not experience any SSO.
- The velocity of the flow will not be included in this evaluation to simplify the process and avoid and possible SSO conditions. This procedure will ensure a quick response time where conditions merit.

If a flood warning is eminent, the sanitary sewer critical zones will be inspected and cleaned as needed.

TRIGGERS

This SOP will be active twice monthly and any condition that deviates from normal operating standards will initiate the notification process.

ACTIVITIES LOGGING

A daily logging system will be included to track specific activities and the results that have been found utilizing this SOP.

Written By: John P. Farrier

Approved By:

Approval Date:

Revision #: 0

Revision Date: April 27, 2007

Revised By:



CITY OF READING, PENNSYLVANIA

Sewer System SOP

DRAFT

SUBJECT: Storm Sewer Collection System Inspection

PROCESS DESCRIPTION

The routine inspection of all storm sewers and catch basins located in high flow zones. The inspection of manhole locations for any conditions that may cause high flow condition is required to ensure that no storm related flooding will be experienced. Inspections will be conducted based on predetermined zones that have been located by past experience from flooding occurrences. Inspections will also be conducted with respect to the Safety Description and Methods & Actions section of this SOP.

SAFETY DESCRIPTION

All safe working standards will be followed at all times, with consideration to safe equipment operation and proper lifting practices. Head, Foot, Hand, Ear and Eye protection will be used. A manhole cover removed with a manhole pick or hook when a truck mounted lifting crane is not available. A catch basin grate must be removed with a truck mounted lifting crane. Manhole inspections will be conducted using " OSHA Code of Federal Regulations, CFR Title 29 part 1910.146 Standards" (Permit – required Confined Space) Atmospheric monitoring equipment will be used with respect to the Federal Regulations and the departments confined space check list will be utilized. The crewmembers will monitor for concentration levels of hydrogen sulfide, carbon monoxide, explosive conditions and oxygen levels to ensure a safe working environment. No crewmember will enter a manhole that has been declared unsafe for human exposure without the proper safety equipment for the environment. Self contained breathing apparatus (SCBA) will be used if entry to a manhole must be performed. Crewmembers will work in pairs (2 crew members) at all times.

NOTIFICATION PROCESS

The Systems Superintendent and Foreman will be contacted when,

- A trigger event has occurred as identified below,

The Wastewater Superintendent and the WWTP on duty Shift Supervisor must be contacted whenever:

- A treatment unit function may become outside the parameters set by the WWTP SOP's and/or the established WWTP Process Control Plan.

AUTHORIZED ACTIVITIES

The responsible crew members will inspect all designated flood zones to ensure that the storm collection system has no apparent impediments to the normal flows that have been established.

AUTHORIZED PERSONNEL

All sanitary and storm sewer crew members are covered by this established SOP.

METHODS & ACTIONS

Work orders will be generated routinely for crewmembers to inspect and clean storm sewer high flow zones of the City of Reading. This will ensure the storm sewer systems will maintain proper flows at all times.

A catch basin grate must be removed with a truck mounted lifting crane. The catch basins will be cleaned of all material that has accumulated in the catch basin and lateral discharge mains will be cleaned.

All safety practices outlined in this SOP will be followed to avoid any possible injuries to crew members.

Proper traffic control methods will be used at all times. The traffic control methods used will be in compliance with City standard practices and Pennsylvania Department of Transportation standards. Methods will include, traffic lane closings, flaggers, lane closed or road closed signs placed at the proper location, traffic directional arrow boards, barricades and traffic cones as required.

If entry to a manhole must be performed the following equipment must be used: safety harness with life line, tripod and winch for entry and removal of a crewmember or crewmembers, self contained breathing apparatus (SCBA) gear will be on site and used if the environment is considered hazards, ventilation blowers will be used at all manhole locations that must be entered.

Manhole inspections will be conducted and the following information will be recorded.

- Removal of the manhole cover and inspection to the condition of the cover will be conducted
- The condition of the manhole rim, flanges, walls and bottom will be recorded.
- Inspection will record and build up of grease, roots and anything that would impede the proper flow of the system at the location. Cleaning of the manhole location will follow as needed.
- The flow through the manhole location will be established by the method of this SOP. System flow measurement will be made using the basic calculation: diameter of the line feeding the manhole divided by the depth of the flow. This factor will be logged on the inspection log form. When this is less than 2 (the flow is more than half-pipe in depth), the line will be scheduled for cleaning to ensure that the system will not experience any SSO.
- The velocity of the flow will not be included in this evaluation to simplify the process and avoid and possible SSO conditions. This procedure will ensure a quick response time where conditions merit.

If a flood warning is eminent, the storm sewer critical high flow zones will be inspected and cleaned as needed.

TRIGGERS

This SOP will be active two times every month and any condition that deviates from normal operating standards will initiate the notification process.

ACTIVITIES LOGGING

A daily logging system will be included to track specific activities and the results that have been found utilizing this SOP.

Written By: John P. Farrier

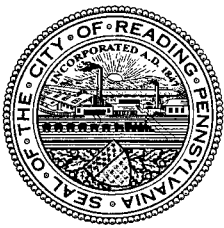
Approved By:

Approval Date:

Revision #: 0

Revision Date: April 27, 2007

Revised By:



CITY OF READING, PENNSYLVANIA

Sewer System SOP

DRAFT

SUBJECT: Post-Event Sanitary and Storm Sewer Collection System Inspections

PROCESS DESCRIPTION

Inspection of all sanitary and storm sewers, high flow zones pertaining after a wet weather condition has subsided. The inspection of sanitary sewer manhole locations for a high flow condition is required to ensure that no unreported sanitary sewer overflow (SSOs) were experienced. Inspection of all storm sewers and catch basins will be conducted to ensure that there has been no flooding related to a storm event. Inspections will be conducted based on predetermined zones that have been located by flow monitoring methods. Inspections will also be conducted with respect to the Safety Description and Methods & Actions section of this SOP.

SAFETY DESCRIPTION

All safe working standards will be followed at all times, with consideration to safe equipment operation and proper lifting practices. head, foot, hand, ear and eye protection will be used. A manhole cover must be removed with a manhole pick or hook when a truck mounted lifting crane is not available. A catch basin grate must be removed with a truck mounted lifting crane. Manhole inspections will be conducted using “ OSHA Code of Federal Regulations, CFR Title 29 part 1910.146 Standards” (Permit–required Confined Space) Atmospheric monitoring equipment will be used with respect to the Federal Regulations and the departments confined space check list will be utilized. The crewmembers will monitor for concentration levels of hydrogen sulfide, carbon monoxide, explosive conditions and oxygen levels to ensure a safe working environment. No crewmember will enter a manhole that has been declared unsafe for human exposure without the proper safety equipment for the environment. Self contained breathing apparatus, (SCBA) will be used if entry to a manhole must be performed. Crew members will work in pairs (2 crew members) at all times.

NOTIFICATION PROCESS

The Systems Superintendent and Foreman will be contacted when,

- A trigger event has occurred as identified below,

The Wastewater Superintendent and the WWTP on duty Shift Supervisor must be contacted whenever:

- A treatment unit function may become outside the parameters set by the WWTP SOP's and/or the established WWTP Process Control Plan.

The procedure for contacting a Shift Supervisor is to contact them by radio, cell phone, or in person.

AUTHORIZED ACTIVITIES

The responsible crew member will inspect designated sanitary and storm sewers high flow zones to ensure that the sanitary and storm sewer systems are free flowing and with no impediment to the normal flows.

AUTHORIZED PERSONNEL

All sanitary and storm sewer crew members are covered by this established SOP.

METHODS & ACTIONS

Work orders will be generated after a wet weather condition has subsided for crewmembers to inspect and clean the sanitary and storm sewers high flow zones. This will ensure the sanitary and storm sewer systems will maintain proper flows at all times, minimizing any SSOs.

A catch basin grate must be removed with a truck mounted lifting crane. The catch basins will be cleaned of all material that has accumulated in the catch basin and lateral discharge mains will be cleaned.

All safety practices outlined in this SOP will be followed to avoid any possible injuries to crew members.

Proper traffic control methods will be used at all times. The traffic control methods used will be in compliance with City standard practices and Pennsylvania Department of Transportation standards. Methods will include, traffic lane closings, flaggers, lane closed or road closed signs placed at the proper location, traffic directional arrow boards, barricades and traffic cones as required.

If entry to a manhole must be performed the following equipment must be used: safety harness with life line, tripod and winch for entry and removal of a crewmember or crewmembers, self contained breathing apparatus (SCBA) gear will be on site and used if the environment is considered hazards, ventilation blowers will be used at all manhole locations that must be entered.

Manhole inspections will be conducted and the following information will be recorded.

- Removal of the manhole cover and inspection to the condition of the cover will be conducted
- The condition of the manhole rim, flanges, walls and bottom will be recorded.
- Inspection will record and build up of grease, roots and anything that would impede the proper flow of the system at the location. Cleaning of the manhole location will follow as needed.
- The flow through the manhole location will be established by the method of this SOP. System flow measurement will be made using the basic calculation: diameter of the line feeding the manhole divided by the depth of the flow. This factor will be logged on the inspection log form. When this is less than 2 (the flow is more than half-pipe in depth), the line will be scheduled for cleaning to ensure that the system will not experience any SSO.
- The velocity of the flow will not be included in this evaluation to simplify the process and avoid and possible SSO conditions. This procedure will ensure a quick response time where conditions merit.

TRIGGERS

The end of a wet weather condition and subsequent flow subsidence in the collection systems is the trigger point.

ACTIVITIES LOGGING

A daily logging system will be included to track specific activities and the results that have been found utilizing this SOP.

Written By: John P. Farrier

Approved By:

Approval Date:

Revision #: 0

Revision Date: April 27, 2007

Revised By:



CITY OF READING, PA

WWTP SOP

SUBJECT: STORM FLOW SOP for the WASTEWATER TREATMENT PLANT

PROCESS DESCRIPTION

Wastewater flows through the collection system and into the Fritz Island Wastewater Treatment Plant (WWTP). The majority of wastewater entering the plant is pumped from the Sixth & Canal Pump Station through a 42" force main to the Primary Clarifiers Diversion Box.

Wastewater also flows through a 36" pressure line from the Fritz Island Grit Chamber (FIGC) to the WWTP. A gravity sewer line and a force main from Cumru Township connect to this 36" pressure line. There is also a 20" pressure line that runs from the FIGC in parallel to the 36" pressure line. These lines all combine into a 30" line for flow metering before discharging into the Primary Clarifiers Distribution Box.

The flow rates of the 42" and 30" lines are measured by a Venturi meter and a mag meter respectively, and recorded by chart recorders located in the Fritz Island Operator's Room. During periods of above normal flow the F.I. Operator and the Pump Tender must pay close attention to the combined flow of wastewater entering the WWTP. Our main objective is to get all of the flow from the remote pump stations, gravity sewers and force mains into and through the WWTP. If the *influent* flow exceeds and stays at or above 37 MGD than implement the procedures described under METHODS & ACTIONS in this SOP.

SAFETY DESCRIPTION

Always wear gloves and eyewear when operating process equipment. During inclement weather wear the necessary clothing/rain gear. Be careful when working near flooded wastewater treatment units and structures.

NOTIFICATION PROCESS

A Shift Supervisor shall be contacted whenever:

- The overall plant influent exceeds and remains at or above 37 MGD, or
- A remote pump station automatic dialer calls the plant to notify of a storm related high wet-well alarm, or
- A process control decision not considered in this SOP must be made.

The procedure for notifying a Shift Supervisor is to first contact the Shift Supervisor on duty by radio, by telephone or in person.

AUTHORIZED ACTIVITIES

Activities will include but are not limited to: closing, opening and restricting valves, turning pumps on and/or off, monitoring all processes both physically and through the use of the SCADA system.

STORM FLOW SOP for the WWTP

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AUTHORIZED PERSONNEL

FI Operators and Alternate F.I. Operators, Pump Tenders and Alternate Pump Tenders, 6th & Canal Street Operators and Alternate 6th & Canal Street Operators, WWTP Shift Supervisors and WWTP Managers/Supervisors.

METHODS & ACTIONS

The following actions shall be taken in conjunction with the Process Control plan and when the *influent* flow exceeds and stays at or above 37 million gallons per day (MGD):

1. The on duty Shift Supervisor and personnel shall evaluate the type and intensity of any incoming storm to determine whether the storm is a **severe** electrical storm, and if so than should the WWTP and/or pump stations be manually switched to emergency generator power.
2. Avoid the risk of solids washout from the tertiary and final clarifiers by increasing sludge wasting from them if necessary to assure there is minimal sludge inventory (< 6") in all seven (7) of these clarifiers.

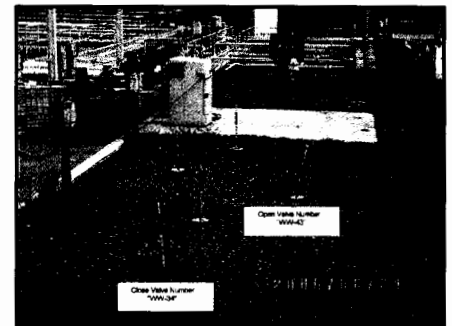


Figure 1.1

3. Open valve WW-43 and close WW-34 located at the Intermediate Pump Station. (See figure 1.1)
4. At the pump control panel located in the Intermediate Pump Station turn Intermediate Pumps #1 and #2 to the OFF position. Observe that the pumps have shut down by making sure the display on the VFD shows "0000". After you have confirmed both pumps are OFF, turn pump #1 and #2 on hand. (See figure 1.2)
5. Restrict Intermediate Clarifier #2 by approx. 30%¹. Intermediate Clarifier #2 will have to be monitored closely by the F. I. Operator and the Pump Tender to make sure an overflow does not occur.

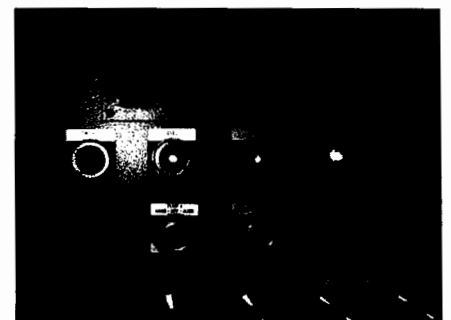


Figure 1.2

¹ Since August 31, 2006 this operation is already completed for normal operation

STORM FLOW SOP for the WWTP

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6. Confirm the recirculation for the Secondary Trickling Filters is closed and off by pushing the CLOSED button until the valve stops moving. (See figure 1.3)
7. Turn on Tertiary Pump Station Pump #5². (See figure 1.4)
8. Begin monitoring the Primary Clarifiers' scum collectors to assure they don't get jammed under the odor covers.

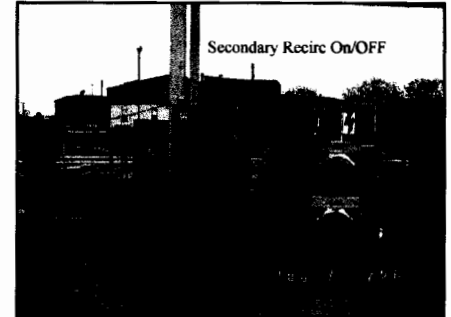


Figure 1.3

The following actions shall be taken in conjunction with the Process Control plan and when the *influent* flow exceeds and stays at or above 45 million gallons per day (MGD):

9. Open the Primary Clarifier #4 influent valve all the way. It is normally restricted by 14 turns.
10. Once the Primary Clarifier #4 influent valve is open all the way the F.I. operator shall pump more frequent primary sludge cycles from its raw sludge withdraw line to keep the raw sludge withdraw line from becoming clogged with grit.
11. At a minimum of every half hour monitor **all** clarifiers and distribution boxes to control and prevent any overflow with-in the plant where possible. Especially monitor the Intermediate Clarifier #2 and the final clarifiers distribution box.
12. Routinely recheck the primary clarifier levels and turn off the scum collectors before they float and get damaged when they catch the underneath of the odor covers.
13. Also at a minimum of every half hour monitor the overflow pipes located at the Intermediate Clarifier #2 distribution box and in the Tertiary Pump Station for an overflow.
14. Turn off 1 blower in Tertiary Aeration. Turning off 1 blower in Tertiary Aeration will help to prevent solids washout from the Tertiary Aeration Cells.

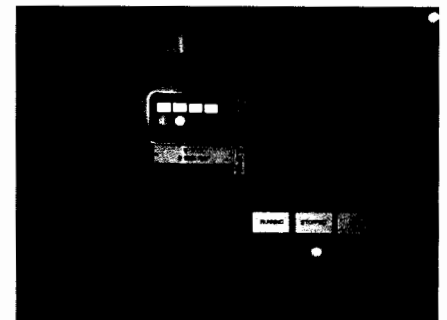


Figure 1.4

² Pump will normally be off. Switch Auto/Hand to Hand, Push button to turn pump on

The following actions shall be taken in conjunction with the Process Control plan and when the *influent* flow exceeds and stays at or above 53 million gallons per day (MGD):

15. Open the influent valve to the Tertiary Clarifier #2.
16. We are treating 100% of the forward flow until the at Trickling Filter #4 discharge sluice gates are changed **or** we have an overflow event with-in the plant. As long as 100% of the forward flow is being treated we are only in Storm Flow mode.
17. Therefore, change the Trickling Filter #4 discharge sluice gates only as a last resource. (See figure 1.5)

We transition into High Flow mode once an overflow occurs with-in the plant or the Trickling Filter #4 discharge sluice gates are changed. High Flow events are reportable under regulatory requirements.

18. Once we transitioned into High Flow mode, immediately notify the on duty Shift Supervisor and log the date, time, overflow location and influent flow rate in the F.I Operators logbook.
19. Once the influent into the treatment plant has peaked and starts to consistently decrease, then reverse the METHODS & ACTIONS, items 20 – 1. These items should basically follow reverse order.
20. Once we transition back out of High Flow mode, immediately notify the on duty Shift Supervisor and log the date, time and influent flow rate in the F.I Operators logbook.

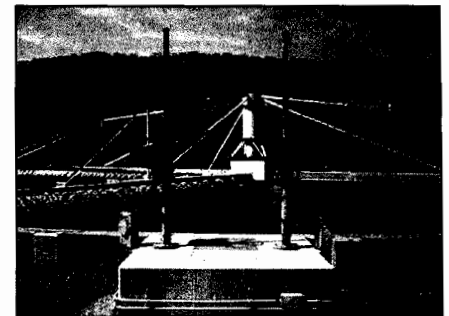


Figure 1.5

STORM FLOW SOP for the WWTP

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TRIGGERS

- Weather reports indicating inclement weather is approaching that may cause the WWTP to be converted into Storm Flow mode.
- If the *influent* flow exceeds and stays at or above 37 MGD.
- A remote pump station sends a high wetwell alarm to the WWTP due to a Storm Flow event.

ACTIVITIES LOGGING

- All activities involved in a Storm Flow event shall be documented by the F.I. Operator and the Pump Tenders in the Operators logbook. This includes all process control decisions, valve changes, process changes due to storms, etc. When documenting activities please included any and all pertinent information including date, time, change, flows, and person(s) involved.
- Activities logging shall also be completed by the on duty Shift Supervisor in the Shift Supervisors logbook. Specifically any information pertaining to a High Flow event in which our forward flow is no longer going through 100% of the treatment process.

Written By: Robert E. Gensemer

Approved By: Ralph E. Johnson

Approval Date: May 07, 2007

Revision #:

Revised By:

Revision Date: